CIVIL ENGINEERING

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See page 395 et seq.

Volume 2 — AMERICAN SOCIETY OF CIVIL ENGINEERS FOUNDED 1852 — *Number 6*

JUNE 1932

Among Our Writers

D. C. LINSLEY was one of the locating engineers sent out by the Northern Pacific Railway in the spring of 1870. Apart from his diary and supplementary material on this particular reconnaissance, recently discovered in the files of the railway company at St. Paul, nothing has been found regarding his life and professional achievements.

R. W. PARKHURST has had exceptional opportunities to practice engineering in little known countries. Since the war his chief connections have been with the Barber Asphalt Company of Philadelphia as Engineering Representative for India, Burma, and Ceylon; as Engineering Representative for Australasia with the same company; and since 1928, as Engineering Representative for the same territory with the Trinidad Lake Asphalt Operating Company, Ltd., of Philadelphia.

FRANK W. SKINNER is especially well known as the former editor of the *Engineering Record*, for which he wrote many well remembered articles on construction methods. Before taking over that editorship he had designed the superstructure of the St. John's Bridge over the Bay of Fundy, the second cantilever structure in America; superintended the shop work for the Mississippi River Bridge and other large bridges; and held the position of assistant engineer on the construction of the Washington Bridge across the Harlem River, New York. He is the author of the three-volume work, *Types and Details of Bridge Erection*. Since 1915 he has devoted his time largely to private consulting practice, to lecturing, and to the writing of technical articles.

WILLIAM BOWIE, Chief of the Division of Geodesy of the U.S. Coast and Geodetic Survey, has been connected with the Survey for the past 35 years, first on field work in the United States, Porto Rico, Alaska, and the Philippine Islands; and since 1909, as Chief of the Division of Geodesy. He is the author of *Isostasy* and several publications issued by the Survey as well as of numerous articles in engineering periodicals.

R. H. SHERLOCK graduated from Purdue University in 1910. From that time until 1916 he was with the American Bridge Company, which he left to engage in general structural design and take charge of field construction on various projects. His connection with the University of Michigan, in teaching and research work, dates from September 1923. He is now Associate Professor of Civil Engineering there.

M. B. STOUT, after serving in France with the 15th Engineers, graduated in 1920 from the University of Michigan, where he received his M.S. degree in 1924. From 1920 to 1922 he was an electrical engineer for the Westinghouse Company. Since 1922 he has been continuously connected with the University of Michigan, doing teaching and research work, since 1928 as Assistant Professor of Electrical Engineering.

WILBUR J. WATSON, graduate of the Case School of Applied Science, has been since 1907 in private practice in Cleveland as consulting, designing, and supervising architect and engineer for many bridges and commercial and factory buildings. Among the recent projects carried out by his firm are the Airship Factory and Dock at Akron, Ohio, for the Goodyear Zeppelin Corporation, and the Lorain-Central Bridge. In 1930 he received the honorary degree of Doctor of Engineering from the Case School of Applied Science.

WILLIAM D. JOHNSON is making a careful study of street railways and their problems and has collected a large amount of data on which his article is based. He is a member of the Corps of Engineers, District of Columbia National Guard, and is employed in divisions of the U.S. Bureau of Standards on engineering work.

AUGUSTUS GRIFFIN has had wide experience in operation and maintenance of irrigation works both in the West and in Canada. He served as engineer for the Modesto Irrigation District in California, as superintendent of the Truckee-Carson (Newlands) Project at Fallon, Nev., and as chief engineer for the South San Joaquin Irrigation District, Calif. Since 1918 he has been Superintendent of Operation and Maintenance of the Eastern Section of the Canadian Pacific Railway Irrigation System.

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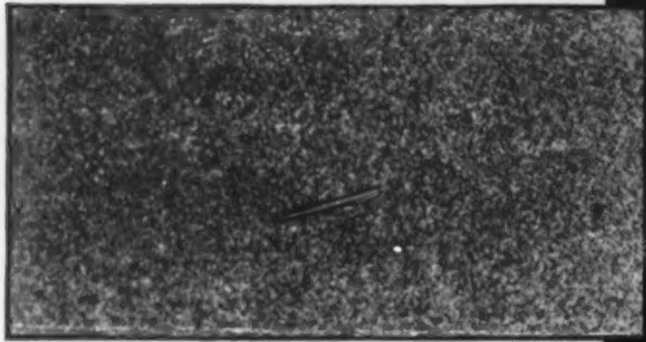
Surface texture on Bitumuls Retread



Bitumuls retread on a Tompkins County road, New York State. Thickness varied from 1 in. to 4 in., to even up depressions in old base.

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CIVIL ENGINEERING

JUNE 1932

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VOLUME 2 NUMBER 6

Pioneering in the Cascade Country

Old Records Bring to Light Details of Railway Reconnaissance in the Northwest in 1870

From the Diary of the Late D. C. LINSLEY
LOCATING ENGINEER, NORTHERN PACIFIC RAILWAY COMPANY

IN an unexplored, snow-covered wilderness at the crest of the Cascade Mountains, a hundred miles from the nearest white settlement, his only companions Indians unable to speak a word of English, an engineer was seeking a low pass for a railroad line in the spring of 1870. The diary of this intrepid engineer has just been uncovered in the offices of Chief Engineer Bernard Blum, M. Am. Soc. C.E., at the headquarters of the Northern Pacific Railway Company in St. Paul, Minn. It was written by D. C. Linsley, a New Englander, and chronicles, with human interest detail, his heroism and dogged determination in performing his mission for the Northern Pacific, to locate a feasible mountain pass for a railroad line in the extreme northwestern corner of the United States. In the ten weeks between May 25 and August 3, 1870, he traveled 650 miles on foot, in canoe, and on horseback, mapping and charting a new country, then inhabited almost solely by Indians. Today maps of that country show the location of "Linsley's Pass," named in his honor, at the headwaters of the Wenatchee River in the State of Washington. Records of the Northern Pacific Railway have revealed nothing more concerning the career of this dauntless reconnaissance engineer.


© Northern Pacific Ry.
SNOQUALMIE FALLS

SPECIFICALLY, the duty assigned to D. C. Linsley on April 28, 1870, by Edwin F. Johnson, then chief engineer of the Northern Pacific Railway, was to make a reconnaissance of the country near latitude 48° north, between the west boundary of Idaho Territory and the Pacific Ocean, to determine the practicability of carrying the main line of the Northern Pacific in that direction from the Clarke River Valley to Puget Sound.

At that time the Northern Pacific was in the earliest stages of constructing the first northern transcontinental railroad, and was planning in the next few years to build a line through the Cascade Mountains. Mr. Linsley was one of a number of engineers sent out to find a practicable pass for the railroad. In pursuance of his instructions, Linsley and his party started from Seattle eastward and made a complete circle, going first up the Skagit River and returning to Seattle via the Columbia, Yakima, and Cedar rivers. He approached the summit of the Cascades twice in the course of the exploration and reported on two possible passes over the mountains.

The start of the Linsley adventure was from Whatcom, now Bellingham, Wash. The story, as graphically told in the little leather-bound volume recently unearthed, continues as follows:

"May 25, 1870—. . . . Left Whatcom at 8 a.m. in two canoes for the Cascade Mountains via Skagit River. Party consists of H. C. Hale, Frank Wilkinson, and John A. Tennant [a resident of Whatcom], myself, and six Indians. . . . Coasted along the east shore of Bellingham Bay southerly to Swinomish River. Reached the house of the Indian agent, Dr. Deree, and was most hospitably received by him. Found we are natives of the same town. Distance traveled, 25 miles."

The second night of the journey was spent at W. H. Sartwell's, a short distance up the Skagit. This was in low country and Linsley notes the width of the river and its comparative shallowness. The shores were wooded, mostly with cottonwood and alder trees. The cottonwoods grew to a huge size; one, measured 6 ft. above the ground, was 27.9 ft. in circumference. From Sartwell's the party went on up the Skagit.

"Friday, May 27—. . . . At noon we had passed the portage and a heavy rain having set in, we camped on the west bank of the stream. Here we met Sosumpkin, chief of the Skagit tribe of Indians. After a long talk participated in by nearly every grown member of the tribe present, we succeeded in procuring canoes and Indians to continue the ascent of the river. The canoes we have had to this point are constructed for use on the sound and are quite different in shape from the river canoes. . . . Fir, spruce, and cedar are beginning to appear and are of giant size. I measured two cedars, 6 ft. above the ground. One measured 20 ft. and the other, 24 ft. 8 in. in circumference. . . . We have passed the last settlers' cabin and are fairly in the Indian country."

That night it began to rain and the river rose to freshet stage, making progress against the current hard work. They saw "immense cedar, fir, and spruce trees floating down the stream with their enormous roots

and branches grating and crushing against the rocks at the bottom with a noise that could be heard a long distance." Notwithstanding almost constant rain the river fell slightly. The diary continues:

"Monday, May 30—. . . . We noticed, today, evidence of the extraordinary durability of the cedar of these forests. The stump of a cedar 7 ft. 6 in. in diameter had been hollowed out by fire until the shell was only some 6 to 10 in. thick, with a jagged and splintered top, some portions of which were 20 to 25 ft. high. Inside this stump is now growing a spruce tree 10 ft. 2 in. in circumference. . . . After making about ten miles we camped at the mouth of Baker's River. . . . It comes in from the north and has its source among the glaciers of Mount Baker. The Indian name is *Novoulturn*, signifying 'white water.'"

By May 31 the party had reached the mouth of the Sauk River, which, as shown in Fig. 1, enters the Skagit from the south, and began its ascent.

"Tuesday, May 31—. . . . Being anxious to save our rations which, owing to the slow progress we are able to make, are in danger of giving out, I camped early to give our hunter a chance to try his hand. He returned just at dusk with one old bear and two cubs as a result of his hunt.

"From all the information I can get from the Indians, there is no prospect of finding any pass through the mountains to Lake Chelan, but in order to ascertain definitely whether this is so I have concluded to make a hurried trip in that direction, leaving the bulk of the party here to await the arrival of Mr. Hale [who had been left at Sartwell's to keep an hourly record of temperature and barometric pressure]. . . .

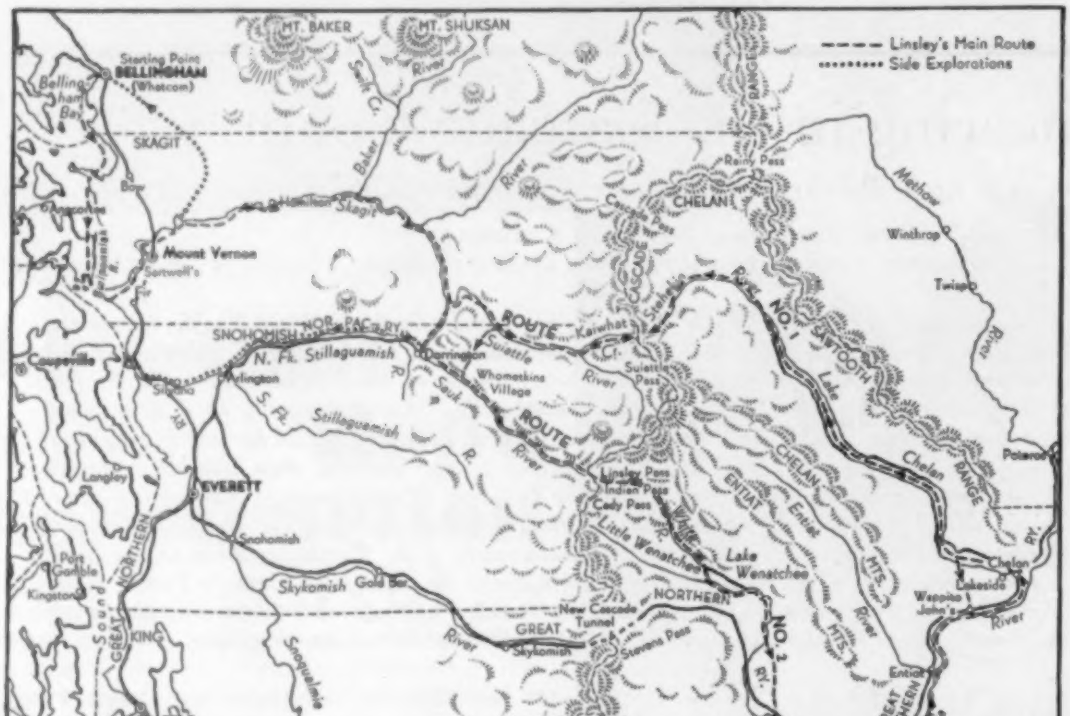


FIG. 2. FROM PUGET SOUND TO THE COLUMBIA RIVER
In the Vicinity of the Forty-Eighth Parallel

"Wednesday, June 1—. . . . Remained in camp all day preparing to divide party and rations to make an exploration in the direction of Lake Chelan. The Indians make great objections to going, and I may be compelled to await at this place Mr. Hale's arrival. A grand pow-wow is going on tonight among them in relation to this matter, and speech-making enough for half a dozen political meetings is being done. The only objection they make is that the route is so hard.

"Thursday, June 2—. . . . Another long pow-wow this morning which finally resulted in a new trade by which I am to give the Indians an advance of 30 cents per day for canoe work after this date, the wages when in camp or traveling on foot to remain the same as heretofore. . . . It was nearly nine o'clock before we got off. I took with me Mr. Tennant and four Indians, leaving Mr. Wilkinson in camp with the remainder of the party. . . . We lunched upon salmon, which the Indians had taken with a spear. . . and at three o'clock commenced the ascent of the Suittle [Suiattle]."

The party of Mr. Linsley reached the head of navigation on the Suiattle River for canoes by Sunday.

"Sunday, June 5—. . . . We left our camp, our canoe, and every pound of baggage that could possibly be spared, at 6:30 [a.m.] and proceeded up the valley of the stream. The trail is very straight and no one but an Indian could possibly follow it."

At noon they left the Suiattle and turned into a creek entering it from the east, the Kaiwhat, probably the present Sulphur Creek.

"From the north bank of this creek the snow peaks rise almost perpendicularly. Any number of little rivulets creep out from under the enormous snow banks and tumble down the rocky sides of the mountains. I noticed one which I estimated fell 1,000 ft. in a nearly

perpendicular descent. The timber on the Kaiwhat is the best I have seen. The cedar particularly is most remarkable. I think on some acres 20 trees might be cut that would square 15 in. for 50 ft. and be perfectly straight. The fir timber is also very fine, thick, and thrifty, but not so large as I have seen lower down. . . .

"Monday, June 6—I spent two hours this morning in a partially successful attempt to repair one of the barometers. . . . Our route continued up the Kaiwhat, mostly through open woods of magnificent fir and cedar timber with occasionally an alder thicket or a windfall for variety. . . .

"At three o'clock I saw two cinnamon or brown bears quietly feeding in plain view not more than 300 ft. distant. One was a very large animal and the other apparently but one or two years old. Mr. Tennant had the only rifle in the party. He fired at and wounded the large one but it escaped. . . . We camped on the edge of a snow bank at the foot of a very steep ridge. . . which the Indians tell us is the pass."

Pass to Lake Chelan from Kaiwhat Creek Reached

"Tuesday, June 7—We left our camp at 4:15 this morning to ascend the mountain, over which is the pass to Lake Chelan. . . . Although the summit of the pass is distant from our camp but about one and one-half miles and we had no luggage, yet so steep and difficult was the ascent that with the utmost diligence we did not reach the summit until half past seven a.m. . . . The elevation of the pass is 6,135 ft. above tide. The old Indian trail passed through at its lowest point. . . . The pass is practicable for a railway only with a tunnel, which would be a mile to a mile and a half in length, depending upon the elevation at which the tunnel was made. . . . The entire formation of the mountains about is granite. I noticed close by the summit . . . the red snow found only at great elevations. We found also the ptarmigan and Scottish heather. Only a slight examination was required to show that the point we were upon was the only one by which a road could pass out of the valley we were in eastward. After taking such observations as we were able to with the instruments we had, we prepared to return. . . .

"In coming down I practiced the plan pursued by the Indians, to wit, sitting down upon the snow and allowing the force of gravity to take me down, using a stout stick as a brake to regulate the speed. It may not have been . . . the most dignified pose of traveling known, but it was an eminently successful one in my case. We reached our camp of last night at 11:30 a.m., and as we were thoroughly soaked with melted snow and had had a hard tramp, I determined to go no farther today."

Running the Suiattle in Flood

During the following day the return trip to the point where the canoe had been abandoned was made in a forced march of 25 miles through dense forests without any kind of path except one that an Indian could find. The next day was:

"Thursday, June 9—. . . . There was a long conference among the Indians last night in relation to the possibility of going down the river in a canoe while the water is at its present stage. It seems to me utter madness to attempt it, but I had determined to abide by their decision if backed by the opinion of Mr. Tennant. It was finally agreed that the Indians should take all the luggage in the canoe and try the navigation, while Mr. Tennant and myself proceeded on foot along the shore.

"We proceeded thus about two miles when the Indians advised us to get in the canoe, saying the worst water to be met for several miles had been passed. We did so after following the suggestive advice of the boatman to put off our pistols, coats, etc., and to sit upright in the bottom of the canoe. Mr. Tennant was given an

© Northern Pacific Railway

Monte Cristo Canyon, Stillaguamish River, Washington
One of Linsley's Assistants Explored This Route

Indian bucket, and the bread pan was placed in my hands, with an intimation that in case the canoe shipped much water it would be well enough for us to throw it out. The Indians, stripped of all clothing save a shirt and belt, stood up, two in each end of the canoe, each having at his feet a paddle and in his hands a stout pole some 12 to 15 ft. long.

"They push out from the little eddy in which our frail craft is rocking gently. The current seizes the bow of the canoe and in an instant we are whirling down the stream at a fearful rate. It is comparatively smooth water here, but just ahead a line of white and tossing foam stretches entirely across the stream from bank to bank, broken only by the dark tops of boulders that occasionally for an instant appear above the surface of the current. To enter that line of barring breakers seems the wildest madness, but it is now too late to avoid them. The eye gathers in an instant all the surrounding objects. The glancing shores show the fearful rate at which we are going. We notice the enormous size of the rocks ahead and wonder at what point we are going to be plunged beneath the torrent. . . .

"Attention is drawn to the Indians. Their usual listless manner is gone. Each has assumed an attitude that would form a fit subject for a sculptor. Their black eyes, fairly glistening with excitement, are riveted on the wild whirls into which we are rushing. But we are close upon the foremost breaker. A volley of gutterals breaks forth from the chief in the stern and is answered by similar sounds from each of the crew. The poles are dropped to the bottom and by an instantaneous and powerful jerk the canoe's course is changed a trifle, so that it clears by a hand's breadth the first rock we meet. A frightful barrier is just ahead. The poles are again thrust to the bottom. One is broken in a twinkling, but before our eyes have assured us of the fact, the holder has grasped a paddle and is working it with desperate energy.

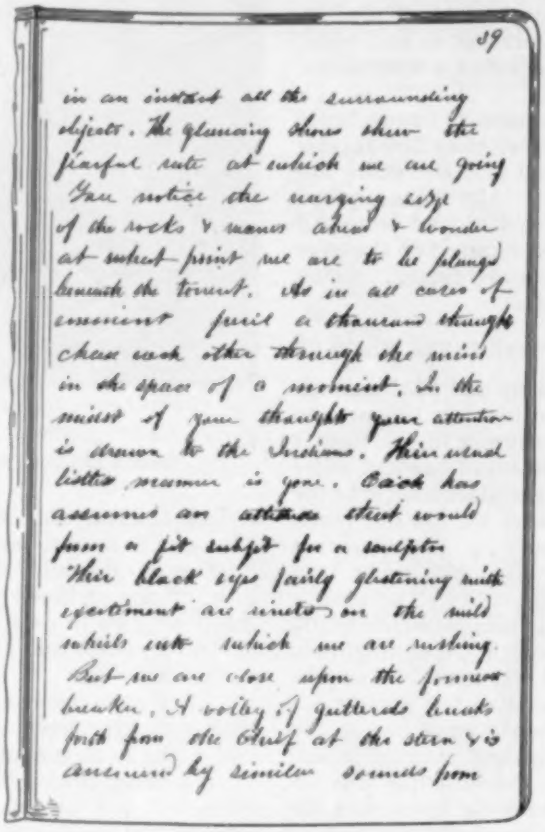
"The bow of the canoe meets the barrier. . . . The Indians totter. . . . A spray flies over us, and a barrel of water pours into the canoe. We work our bailing dishes with all the strength we can muster. We catch glimpses of the rocks as we fly by. The canoe tosses and whirls

in every direction, apparently ungovernable but really controlled with amazing dexterity. The water now dashes over the side of the canoe incessantly and we literally bail for life. A moment more and the triumphant shout of the Indians rises above the roar of the water and announces that we are for a moment safe. After several miles of this kind of navigation, the Indians pulled up and announced their conviction that it would be unsafe to proceed further until the water falls."

In this opinion Linsley heartily concurred, and drenched to the skin the party landed and proceeded to get dry.

As there was no improvement in the river the next day, Mr. Linsley and Mr. Tennant left the Indians to take the canoe on down the river, and crossed the mountain separating the Suiattle and Sauk rivers to the camp established by Mr. Wilkinson. Here they found an Indian village, and were met by Chief Whometkan's son, who promised any assistance his tribe could give. Most of the tribe were absent on a fishing expedition but on their return the personal services of the chief himself were secured for the trip over the Cascades.

"Thursday, June 16—Sosumpkin returned at dusk with a note from Mr. Tennant dated this morning, at the head of navigation on the Sawk [now Sauk]. It seems Sosumpkin has proved faithless, and after going to the head of navigation [on the Sauk] under the clearly understood arrangement that he was to go over the mountains for horses, he, at the last moment, refused flatly to go. It won't do to discharge him just yet as he has too much influence below here on the river. But I hope in a few days to let him go. The water in the streams has again become clear enough to get salmon, and the Indians killed four today. They take with them a spear about 17 ft. long, forked at the end with a barbed point of iron or horn stuck loosely on each prong of the fork.... The barbed points pull off the ends of the spear, but the fish is held and pulled on board by the thongs which attach the barbed points to the spear. If the barbs were fixed rigidly on the end of the spear, the floundering of the fish would break the slender spear...."



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in an instant all the surrounding
objects. The glancing shore shew the
fearful rate at which we are going
You notice the surging edge
of the rocks & waves ahead & wonder
at what point we are to be plunged
beneath the torrent. As in all cases of
eminent peril a thousand thoughts
chase each other through the mind
in the space of a moment. In the
midst of your thoughts your attention
is drawn to the Indians. Their usual
listless manner is gone. Each has
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Their black eyes fairly glistening with
excitement are riveted on the wild
whirls into which we are rushing.
But we are close upon the former
breaker. A volley of gutterals breaks
forth from the Chief at the stern & is
answered by similar sounds from

A PAGE FROM THE LINSLEY DIARY OF 1870, 4 BY 6 IN.
Keeping Paper Dry and Carrying Ink Were Among the Lesser Difficulties

Mr. Linsley remained in camp until the return, on Saturday, of Mr. Wilkinson, who had been long delayed in getting drafts cashed. On Saturday afternoon the party started up the Sauk River in three canoes. With Mr. Wilkinson and Mr. Linsley were 11 Indians. They stopped at Chief Whometkan's village to get a supply of smoked salmon, and there they also bought eight quarts of good strawberries, according to a note in the diary.

The next two days the little party struggled on up the river. On Tuesday they were met by Mr. Tennant, who was returning for more provisions. Mr. Hale had been left at the main forks of the Sauk higher up, where the party later found him comfortably established in a bark hut that he had constructed while he waited. Mr. Tennant had sent Indians on to the Columbia River to get horses and had put others to work opening a trail to the top of the mountain. From this base Mr. Linsley again set his forces in motion. The next entry in the diary reads:

"Wednesday, June 22—.... This morning I dispatched Mr. Wilkinson with one canoe and four Indians to examine the trail leading from the Skagit River to Whatcom on Bellingham Bay; thence to proceed to Seattle and prepare map of our explorations to this point, and then, unless otherwise ordered, meet me on the Columbia River by the way of the Snoqualmie Pass. Mr. Hale I dispatched with a canoe and three Indians to cross over to the Steilagwamish [Stillaguamish] River by the trail before mentioned and thence descend that stream to Puget Sound. I sent letters and dispatches to Governor Smith and home by him, and directed him to hasten up the $600 which I telegraphed General Sprague for last Sunday to have within three or four days, and which has not yet come to hand. I cannot leave the summit until that is received as from that point I expect to travel as fast as a messenger would."

CROSSING THE DIVIDE INTO THE WENATCHEE VALLEY

The next few days Mr. Linsley spent alone in the little camp. The wait was monotonous, broken only by the arrival of four Indians, who returned to pick up more rations to carry to the summit. Mr. Linsley felt he must not go until he received the money that he had sent for, but the arrival of the second party of Indians from Mr. Tennant on Tuesday, June 28, decided him to leave the camp and go on up with one Indian to join Mr. Tennant on the summit.

"Thursday, June 30—.... We reached the head of the valley, which has an elevation of about 3,700 ft. above tide.... Turning abruptly to the left, we ascend a very steep ridge some 1,300 ft. high and stand upon the summit of the pass, 5,042 ft. above the sea. The pass is about 40 or 50 rods wide and half a mile long.... It is bounded on both sides by peaks 1,500 to 3,000 ft. higher than the pass itself.... Seeing a mountain goat or sheep high up on a neighboring peak, I dispatched two Indians to endeavor to get it to add to our stock of rations, which are rapidly diminishing.... About dusk the hunters

returned, having captured their game. It was a buck and the Indians say a large one.

"Friday, July 1—Discharged and sent home all our Indians but three, two of whom are at the camp at the mouth of the forks waiting for a messenger. Indians arrived with horses at a point down the east slope of the mountains about five miles below here, which is as near as they can come on account of the snow. Dined off a goat steak, which, although tough, was well flavored. A fat grouse, known as the blue grouse, furnished me an excellent supper.... A humming bird paid us a visit this afternoon and spent some time about the trees under which we are camped. It is certainly odd for a Yankee to find these forms of animal life where the snow is lying 7 ft. deep on the ground.

"Saturday, July 2—Mr. Tennant and I left camp early this morning and ascended the high peak that bounds the pass to the north.... The elevation was 7,900 ft. above the sea. The view was very fine in every direction.... It is very evident that there is no other pass from the Sawk to the Wenatchee than the one leading from the head of the fork.... We discovered that a pass exists on the north as well as on the south side of this mountain, which, although not as low as the one we have followed, is a much less distance across.... On our way we shot two blue grouse. At 5 p.m. an Indian reached me from the forks of the Sawk with the most unwelcome news that no messenger had reached there up to this morning and that the Indian Albert left there was sick with dysentary. Mr. Tennant started immediately down to him with all our old party. I have left with me only Jim and the two Indians who brought the horses.... I have not rations for more than a week, and I dare not risk keeping the Indians with the horses [from the Columbia] any longer than Wednesday, as they are now anxious to return. My position is a little uncomfortable... on top of the Cascade Mountains with three strange Indians for my only companions, none of whom can talk a word of English...."

A tunnel on the north pass was estimated at one and one-half miles long. On Monday, the Fourth of July, both Mr. Tennant and Mr. Hale arrived at the camp on the summit with the long expected $600. Mr. Hale, after wrecking a canoe on his way down the Stillaguamish River, had gone back to Sartwell's on the Skagit River, obtained the expected money, and returned immediately. He was re-dispatched to Seattle to obtain another $1,000 from General Sprague and directed to meet the party on the Columbia River. The diary continues with the narrative of events on the next day.

"Tuesday, July 5—.... Mr. Tennant and I started for the Columbia River by way of the north pass [marked Linsley's Pass on the map], which I am satisfied is the only practical route....

"Wednesday, July 6—.... We left camp at 5:30 and proceeded down the stream. As we worked our way slowly along the side of the mountain (the thickets bordering immediately upon the streams were almost impossible) we passed close to the feet of a number of most beautiful cascades, several of them having a fall of more than 1,000 ft.... For a mountain line I think this unusually favorable from the summit to this point. As soon as our horses could be packed we started down the stream and found a very good trail...."

STEHEKIN RIVER IN THE CASCADES, WASHINGTON
The "Chelan" River Explored by Linsley

With eight horses, obtained from the Columbia Indians, to carry their baggage, the party proceeded down the Wenatchee River on foot. Mosquitoes were troublesome and the river and its tributaries were high, but by Sunday, the tenth, the intrepid group of men had reached the lower canyon of the river, where it is walled in by mountains of rock from 1,000 to 5,000 ft. high.

"Sunday, July 10—After breakfast...Mr. Tennant and I walked up the canyon about a mile.... The general fall of the river... I estimate at 40 to 50 ft. per mile, but for about a mile at the lower end it falls faster, say 70 to 80 ft. per mile. The stream flows over and around huge boulders of granite and seems one mass of snowy foam. Here the salmon collect in great quantities and hither every year come swarms of Indians to lay in their year's stock of food. Some two or three hundred are now camped along here, all busy as a swarm of bees.

"The fish are taken by means of a barbed hook attached to the end of a slender pole from 15 to 30 ft. long.... The women then take them, cut them up, and hang them on poles to be dried and smoked. As we walked along... [we passed] little groups of women and children clustered among the huge boulders..., sheltered from the burning sun by a few boughs of trees spread on poles supported on forked sticks...."

Mr. Linsley says of this canyon route: "On the whole, I think the valley of the Wenatchee a remarkably favorable one for the construction of a road in this section of the country." From the canyon to the mouth of the Wenatchee the river was found to be crooked, but railroad work would be light.

COLUMBIA RIVER REACHED

"Monday, July 11—[On the Columbia, at the trading post of J. G. Ingrim, who knew all that country thoroughly]. . . . The celebrated chief of the Wenatchee, Moses, who was the most prominent leader in the last Indian war, came into camp. He is by far the finest looking Indian I have seen and is evidently a man of ability. He is wealthy, having large herds of horses and cattle, and has a wide influence over other tribes than his own, with whom his word is law.

"Tuesday, July 12—.... At 2 p.m. started up the river [Columbia] in a canoe borrowed of Mr. Ingrim.... I have determined to try it with our two men, Whometkan and his brother Jim. The Indians about here have nearly frightened them from going with accounts of the 'dead water,' but I have no fear of that.

"Thursday, July 14—.... At eight o'clock this morn-

ing we reached the outlet of Lake Chelan. . . . The water of the lake reaches the Columbia through a very crooked and narrow gorge, walled in by precipitous cliffs of basaltic rock from 400 to 800 ft. high. Lake Chelan is considerably above the Columbia River and its water reaches the latter stream without any perpendicular fall, but by a succession of rapids. . . . At 2:30 we started up the lake and at night camped at a point ten miles above the outlet. . . ."

For the next three days the wind was so terrific that only a short distance could be traveled each day. The canoe that the party had was a most unseaworthy affair, and although they made several starts, were obliged to give up and await the lulling of the wind. The journey was resumed the following Tuesday in a large canoe obtained from other Indians.

NORTHERN PACIFIC LOCATING PARTY, 1879

"Tuesday, July 19—The wind moderated about two this morning and at quarter before three we again started up the lake. After going about two miles, the wind increased and we were compelled to go on shore. At quarter before seven we again started and reached the head of the lake at about 1 p.m. . . . Entering the mouth of the Chelan [now Stehekin] River, we proceeded . . . up the stream, which is here about 150 ft. wide and 1 to 2 ft. deep, with a strong current flowing over a bed of coarse gravel. Having lunched and procured poles for working our canoe . . . we continued on our way about 7 miles and camped on a sand bar.

"The route by Lake Chelan has, on the whole, proved much better than I expected. The length of the lake is about 40 miles. Of this about 6 miles will be very heavy rock work. About one mile of tunneling of various lengths from 100 to 800 ft. About 16 miles will be very easy of construction and 10 miles will be somewhat above the average. Curves of 800 to 1,000 ft. must be used to avoid very expensive work, but the grades will be very light and the greater portion of the way level. I think the distance can be shortened about four miles, but this will be the lightest part of the work. The rock work will be mostly in granite and basaltic rock. This will be hard to cut but a great portion of it will be side work."

The next few days were spent by Mr. Linsley and his party in following the small streams that empty into the Chelan. These streams head near the upper tributaries of the Skagit and the Suiattle and therefore it was possible to connect the exploration made up the Kaiwhat branch of the Suiattle with that of the Chelan. This appeared to be the only practicable connection. Mr. Linsley stated his conclusions as follows:

"Sunday, July 24—The result of the survey, or rather exploration, of the Chelan route is briefly this: The route is practicable with a heavy grade, say 80 to 90 ft., but the work will be heavy and expensive. The land, with the exception of that along the road for about 15 miles from the Columbia River, lying east of the summit, is worthless. The route will be shorter from the sound to the Columbia River than any other.

"About six [this morning] we started on our way back to the Wenatchee, where we had left the greater part of our supplies. We have had nothing on the trip but bacon and flour, and as our yeast powders have failed, it is pretty hard living. The entire stock of cooking utensils and furniture consists of a frying pan, a knife and fork, and a pint tin cup. . . ."

Leaving the canoes to follow as fast as possible, Mr. Linsley and Mr. Tennant on Monday, July 25, made 60 miles to the mouth of the Wenatchee. There Mr. Hale, who had returned from Seattle, met the party with further instructions. Mr. Tennant and Mr. Wilkinson were left to explore the Spokane River while Mr. Linsley and Mr. Hale with an Indian guide made a rapid return to Seattle over the mountains by way of the Snoqualmie Pass and the Cedar River with their findings. They reached Seattle on Tuesday, August 2, and Mr. Linsley notes:

"We reached Seattle at 11:30 a.m., having ridden in the last five days about 200 miles, much of the way over roads next to impassable. I find that since leaving Whatcom [May 25] I have lost 26 pounds in weight."

After further reconnaissances on Puget Sound, Mr. Linsley left Seattle on August 6 to carry his findings to the officers of the Northern Pacific in New York, where he was to report on August 20. In his report Mr. Linsley summarized the possibilities of his explorations in the following words:

"A good route can be had from the foot of Rock Island, three miles below the mouth of the Wenatchee, to the Spokane River with fewer obstacles than between the 'Sound' and the Columbia. Estimate of Route No. 1 from the mouth of the Skagit via Lake Chelan and the Columbia to the Spokane River about 50 miles below Lake Pend d'Oreille and 20 miles above the mouth of the stream. Distance, 326 miles. Cost $16,000,000, or $50,000 per mile.

"Route No. 2, from mouth of Skagit via the Skagit, Sawk, and Wenatchee rivers and across the 'Great Plains' of the Columbia to same point on the Spokane as Route No. 1. Distance 347 miles. Cost, $13,000,000, or $39,000 per mile.

"A line up the Steilagwamish to Sawk summit would reduce the distance 10 miles, and save $250,000 in cost. The estimate would then read: distance, 337 miles; cost, $12,750,000, or $38,000 per mile."

The expedition conducted by Mr. Linsley had very little bearing on the present location of the Northern Pacific line through the Cascade Mountains. It was one of several surveys and reconnaissances to determine the best route. It was neither the first nor the last of these surveys.

The records of the railroad company do not disclose the details of Mr. Hale's long trip from the crest of the Cascades to Seattle and his return to the Columbia at the mouth of the Wenatchee via the Snoqualmie Pass, nor do they describe the difficulties of Mr. Wilkinson's party in exploring a route from the Skagit to Bellingham, or tell by what means Mr. Linsley was able sixty years ago to reach New York from Seattle in 14 days.

A MONUMENT TO THE MASON'S ART, AT CTESIPHON, NEAR BAGHDAD

Remains of One of the Most Magnificent Buildings in Mesopotamia. The Great Vaulted Hall of the Palace Built by King Chosroes I in 550 A.D. Has a Brick Arch 86 Ft. in Span and 95 Ft. to the Crown. The Ornamental Brick Facade at the Left was the Palace Wall.

HISTORIC engineering works dating back to the beginnings of the Christian era may still be seen in ancient Mesopotamia. Such names as Babylon, Baghdad, Damascus, and Ur still stir the imagination, although some of the glamor disappears on contact with the modern counterparts of those old cities, according to Mr. Parkhurst. The notes for this article were taken on one of the overland stages of a trip from Australia to the United States, via India and England. They form a most readable commentary, in terms of present-day observation, on the accounts of early engineering given by J. H. Gandolfo in the April 1931 issue. Not the least interesting part of the present story is that describing the revolutionizing effect of ultra-modern transportation methods recently introduced into the Near East.

Assyrian Engineering, Ancient and Modern

Observations Made on a Trip Through the Tigris-Euphrates Valley

By R. W. PARKHURST

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REPRESENTATIVE, TRINIDAD LAKE ASPHALT OPERATING COMPANY, LTD., SYDNEY, AUSTRALIA

DURING the summer of 1930 it was my privilege to journey overland from Bombay to London. The whole trip was interesting, but from an engineering point of view no part of it was more instructive than that through modern Iraq, the country north of the Persian Gulf, embracing the Tigris and Euphrates Valley, famous since the dawn of history.

Forty centuries ago this territory comprised the all-powerful Assyrian Empire. Following the World War, it was subdivided politically to include Turkey, Syria, Iraq, Arabia, and Persia. Of these, Syria is under a French mandate and Iraq, nominally under King Feisel, is practically under British control. Much development has taken place within these regions during the past decade, particularly as regards transportation. These states are now fairly well served by railways and by motor and air services (Fig. 1).

Even 15 years ago, the only means of travel to Iraq from India was by weekly mail steamer from Bombay to Basrah, via Karachi, a journey of 1,670 miles, requiring 6 days. Recently this has been supplemented by a weekly airplane service conducted by the Imperial Airways. Beginning at Delhi, the planes follow a route through Jodhpur, Karachi, Gwadur, Jask, Lingeh, and Bushire to Basrah. Thence they proceed north (Fig. 1), to Baghdad and westward across the desert to Rutbah, Gaza, and Heliopolis, near Cairo. Although this is unquestionably the most expeditious and comfortable mode of travel in that part of the world, it affords no opportunity of inspecting the country in detail. For such observation the railways or motor services are preferable.

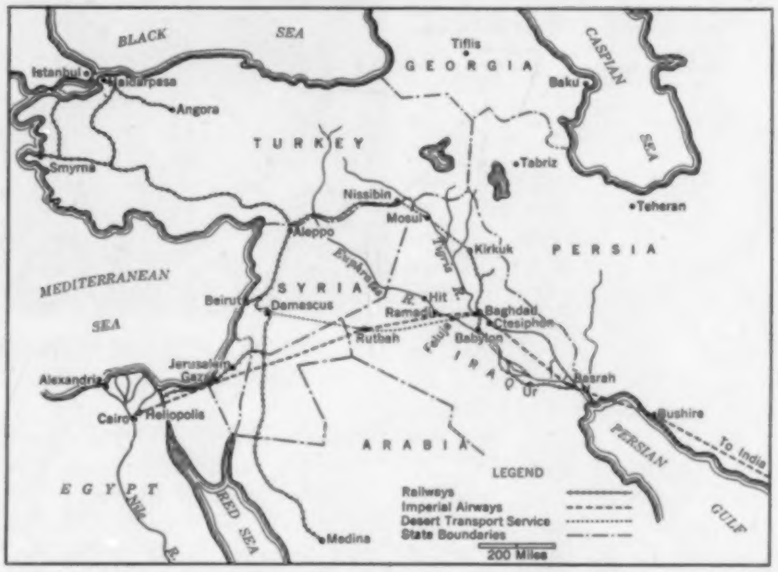

FIG. 1. MAP OF THE MIDDLE EAST, WITH LINES OF COMMUNICATION, 1930

By the narrow-gage Iraq Railways, it is an all-night journey of 125 miles from Basrah to Ur Junction. The railways are run on the Indian system, according to which each first-class compartment, extending the full width of the carriage, is fitted

with two lower and two upper bunks, with adjoining bath facilities. Bedding is provided by the traveler or obtained from the station master.

It is about 2 miles across the desert from the railway rest house at Ur Junction to the excavations on the site of ancient Ur of the Chaldees. Except during the tourist season, one is forced to walk—a procedure that has its drawbacks when the sand blows, as it frequently does in summer. One may wander about the ruins of Ur at will, although "guides" quite without any knowledge of English may attach themselves and demand the customary *baksheesh* of the East. As will be noted from the photograph, the excavations are very extensive and of special interest to the traveler with a knowledge of history and archeology. Attempts have been made to keep the old brickwork in repair.

Some of the Excavations

Ruins of an Ancient Temple

UR OF THE CHALDEES, A BIBLICAL CITY, AS IT APPEARS TODAY

Babylon is a 10-hour journey by rail northward from Ur. For the first 25 miles, the line traverses an extremely arid region, insufferably hot and dusty in summer, after which it enters an irrigated area where the soil is relatively fertile. There is a good rest house at Hillah Station, whence it is about five miles by motor to the excavations of old Babylon. These are rather more extensive than the ones at Ur. There is also a massiveness about the brickwork that is more noticeable. This, however, may be due to better preservation of the masonry. The reliefs done in brick, clearly visible in one of the photographs, are unique. As at Ur, the bricks have been laid in bitumen, probably obtained from one of the natural deposits nearby or brought down the Euphrates from Hit.

TABLE I. PHYSICAL ANALYSIS AND CHEMICAL TESTS OF ANCIENT ASPHALT MASTICS

ITEM	BABYLON	UR
Specific gravity	1.67	1.58
Water	0.80 per cent	0.45 per cent
Color	Brown	Brownish black
Fracture	Indefinite	Indefinite
Bitumen (soluble in CS_2)	17.00 per cent	11.20 per cent
Inorganic insoluble (residue by ignition)	56.60 per cent	56.90 per cent
Difference (organic insoluble)	26.40 per cent	31.90 per cent
	100.00 per cent	100.00 per cent
Color of ash	Gray	Gray
Solubility of inorganic material in H Cl	90.0 + per cent	90.0 + per cent

Compared with the ruins in the Nile Valley, those at Ur and Babylon are unimpressive. Quarries of excellent stone, however, were available for the builders of ancient Egypt, whereas those of the Tigris-Euphrates Valley had to rely solely upon locally burned brick. That these structures have endured as well as they have is a tribute to the skill of the ancient Assyrians.

It is of interest to examine the nature of the bitumen used in these old structures at Ur and Babylon. Small samples removed from the walls and taken to London for testing showed the composition given in Table I. These materials appear to be heavily loaded with mineral matter listed as inorganic insoluble, and are of the mastic type.

In Iraq, asphalt or bitumen from natural deposits is still employed for a number of purposes, including road construction. The 'argest deposit is that of the Abu Gir, near Ramadi on the Euphrates River some 65 miles west of Baghdad. This material is approximately 75 per cent soluble in carbon bisulfide (CS_2) and contains about 16 per cent of mineral matter. A number of other deposits of hard bitumen and seepages

MAUDE BRIDGE, BAGHDAD
Single-Lane Pontoon Structure Over the Tigris River

of bituminous material of a fluid or semi-fluid nature exist, those at Hit on the Euphrates and at Guaiyarah on the Tigris being perhaps the best known. The annual inflow rate for all these deposits is relatively small.

As employed in repairing Baghdad roads, the almost pure bitumen or *sayali* is mixed hot with lime and a

Masonry of the Ancient Temple at Ur
Original Bitumen Still Holds Brick in Place

mineral aggregate until it resembles a mastic, after which it is poured on the road surface and worked into place with a small hand roller. This *sayali* as obtained is really an emulsion and contains about 25 per cent water.

Baghdad, the ancient City of the Caliphs, has been

Part of the Excavations at Ancient Babylon
Bas Reliefs in Brickwork on the Nearer Walls

stripped of all the splendor it once possessed. Sacked and pillaged many times during its long existence, the native city now consists of a series of narrow, crooked streets, rambling bazaars, and unpretentious buildings adjoining the muddy Tigris. The river is spanned by several pontoon bridges, which carry both foot and wheeled traffic, including heavy motor cars. Baghdad is located on level ground and is exceptionally torrid from June to September. During this season business ceases entirely for Europeans between one and four in the afternoon, and practically stops for Iraquis as well.

The hotels, provided with electric light and fans, are

On the Route from Baghdad to Damascus
Desert Transport Crossing the Euphrates River at Feluja, Iraq

clean and comfortable, as those terms are understood in the Middle East. From the tourist's standpoint, there is little to see. The famous Kazimain Mosque with its golden minarets, on the sacred soil of which the unbeliever cannot under any circumstances trespass, does not compare in beauty or majesty with the Moslem shrines of India.

The Ctesiphon Arch, however, makes up to some degree for the lack of points of interest in Baghdad. Standing alone on the plain 20 miles south of the city, this massive structure, built by Chosroes I in 550 A.D., stirs the imagination of the engineer.

In reality it was an immense hall that formed a part of the main palace. The arch itself measures 86 ft. in span by 163 ft. in length, and is 95 ft. in height to the crown, which is 9 ft. thick. The palace was 312 ft. long, 175 ft. deep, and 115 ft. high; and it, together with the vaulted hall, was constructed entirely of burned brick. It is 40 ft. from the ground to the springing line of the arch, but the masonry was carried in horizontal courses to a point 26 ft. higher, the sides of the arch being gradually drawn in until the span at this point is only a little over 70 ft. The walls, 23 ft. thick at the base, were reinforced with 5 rows of bond timbers carried through from front to back. A photograph shows an unusually good view of this remarkable structure, with one of the elaborate palace walls adjoining.

Above the 66-ft. level, the arch is composed of rings of brick laid at an inclination of about 10 deg. It is supposed that the arch was built without centering, the mortar being sufficiently tenacious to hold each brick in place until the entire ring was complete. For the inner 5-ft. thickness of the arch, the bricks were placed flat, but in the outer 4 ft. they were laid at right angles to the face.

Until after the War, travel westward from Iraq was possible only by guarded camel caravan, a journey no European would be likely to attempt if it could be avoided. About 1919, however, two New Zealanders, the Nairn brothers, established a motor service across the Arabian Desert to the Damascus rail-head for pas-

Iraq Railways, a Narrow-Gage Line, at Ur Junction

Nairn Desert Transport Between Baghdad and Damascus

DESERT TRANSPORTATION, 1930

sengers and mail, which reduced the time of travel between Baghdad and London by from 8 to 10 days. A bi-weekly service has been maintained ever since with only occasional interruptions due to tribal wars and political disturbances in Syria.

The desert, which rises to an elevation of nearly 3,000 ft., is not a sandy waste as in Egypt. It has a hard, clayey soil, occasionally rocky, which even supports vegetation in certain localities. Over this the motors have worn tracks so easy to follow that the regular vehicles travel all night. Comfortable American-built coaches make the 530-mile journey between Baghdad and Damascus in about 27 hours, stopping at Ramadi and Rutbah en route. The most modern development is the inauguration of an air service that parallels the Imperial Airways and enables passengers to make the trip in 5 hours. From Damascus one may proceed by motor or train to Beirut to connect with steamers for Port Said, Alexandria, or one of the Adriatic ports, or may take a train direct to Istanbul (Constantinople).

BAGHDAD STREET REPAIRS MADE WHILE YOU WAIT
Bituminous Mastic Is Applied and Rolled by Hand

An alternate route from Baghdad to Istanbul involves a train journey of 165 miles to Kirkuk, a motor trip of about 220 miles to Nissibin on the Turkish Railways, via Mosul, and thence a trip by train direct to Istanbul. This journey requires from 24 to 36 hours longer than the motor route via Damascus. The "Tarus Express" on the Turkish Railways is a thoroughly modern, standard-gage train equipped with the *wagon lits* and restaurant cars of the best European lines, and it is quite comfortable. It is relatively slow, however, 42 hours being required for the 800-mile trip from Aleppo to Haidarpasa on the Bosphorus. The line, especially that part through the Tarus Mountains built by the Germans during the War, is well located, and better speeds could be maintained if occasion demanded.

To travel through this country, even under present-day conditions, is an experience to be long remembered. Perhaps nowhere in the world does the modern scientific transportation so nearly touch the ancient historic past—the cradle of civilization. Any American engineer who has the opportunity will be well repaid for a visit to this part of the Near East. To those who cannot enjoy such a trip in person the photographs produced herewith will give some idea of the old Mesopotamia and the new Iraq.

FROM THE CODE OF LAWS OF HAMMURABI (2200 B.C.)
KING OF BABYLONIA

Facsimile of ancient building code inscribed on a brick found in the Babylonian ruins. Translated by R. F. Harper. Reprinted from the Proceedings of the Brooklyn Engineers' Club, October 1925.

A. If a builder build a house for a man and do not make its construction firm and the house which he has built collapse and cause the death of the owner of the house—that builder shall be put to death.

B. If it cause the death of the son of the owner of the house—they shall put to death a son of the builder.

C. If it cause the death of a slave of the owner of the house—he shall give to the owner of the house a slave of equal value.

D. If it destroy property, he shall restore whatever it destroyed, and because he did not make the house which he built firm and it collapsed, he shall rebuild the house which collapsed at his own expense.

E. If a builder build a house for a man and do not make its construction meet the requirements and a wall fall in, that builder shall strengthen the wall at his own expense.

Development of Erection of Girder Bridges

A Review of the Progress Made in Methods of Placing Steel Spans

By Frank W. Skinner
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With improved mechanical equipment, the girders for bridge spans can now be easily lifted, swung, and seated on their abutments as complete units. Gin poles, gallows frames, and hand tackle have been superseded almost entirely by locomotive cranes up to 100 tons in capacity, by steel movable derricks, and by booms up to 80 ft. in length. Competition has been so keen among bridge erectors that ingenious methods have been devised to save effort and time. From a lifetime of rich experience and observation, Mr. Skinner has selected for inclusion in this article a few outstanding examples of girder erection methods, illustrating the progress made in the last half century.

Bridge erection in the United States and Canada not only has always kept pace with, but also has often developed in advance of, the design and fabrication of superstructures. Like them it has been practically created within the past one hundred years. Many men now living remember well the pioneers who were most prominent in developing methods and appliances for the construction of the first important wrought-iron spans. Our fathers remember when riveted spans were unknown and the construction of wooden and combination spans was a matter of individual design and private enterprise. It was carried out largely without supervision, standard requirements, uniformity of method, or special appliances; almost wholly without mechanical or power equipment of any kind except wedges, jack screws, tackles, and hand windlasses; and wholly without reliable analyses of erection stresses. Within two or three generations steel-bridge erection in this country has attained a degree of precision, efficiency, and general economic perfection far greater than that reached by many other construction operations that have been used for centuries.

The rapid extension of railroads and the great increase in the weight and speed of trains in the last half of the nineteenth century called for hundreds of miles of new bridges and the replacement of great numbers of them that had become inadequate. The erection of these structures was almost always hurried; it was often emergency work, and frequently done under difficult and unprecedented conditions. Following this era of maximum construction of railroad bridges came an astonishing growth in automobile transportation, which likewise demanded an enormous number of bridges of almost every type and span.

Many bridge fabricators erect most of their product, but some of them, as well as some railroads and all highway departments, rely on independent erectors. Competition is so keen, and prices so low, that the most efficient methods are imperative. The great range of local conditions and requirements has necessitated the utmost initiative, speed, and economy, and bridge erectors have developed a high degree of skill, resourcefulness, and flexibility of operations. Their applications of steam, electric, and pneumatic power to field operations have often advanced beyond the current demands and sometimes have actually extended the well defined limits of maximum span lengths and weights.

Bridge erection methods can best be considered in relation to the character and length of spans and to the means of assembling and placing them, which frequently overlap. These methods may be conveniently considered for the erection of short spans and girders as units, and for the placing of viaducts. Girder spans may be erected by unmovable falsework, by cantilevering, by floating into place, by transverse displacement, by protrusion, by a combination of these methods, and by replacement under traffic. A number of these methods are described and illustrated.

Short girders up to about

Placing an $82^1/_2$-Ft. Girder by Hand Methods, Selinsgrove, Pa.
(Center) Unloaded with Gin Poles (Left) Skidded Across on Falsework (Right) Tipped On to the Abutments

150 ft. long with solid webs, or trussed, make up a large proportion of all spans. They are erected in every part of the world, under all kinds of traffic conditions, for every sort of service, sometimes in obstructed or almost inaccessible locations, and often where the utmost speed and extreme safety are demanded, as in overcrowded thoroughfares and trunk railroads.

HANDLING A SPAN WITH GALLOWS FRAMES

The shortest spans are sometimes completely riveted at the shop or else are completely riveted except for their floor and lateral connections, which are riveted in a yard near the site, and the complete unit is then erected as a whole. Sometimes the main plate or trussed girders are shipped in two or three sections each, and field-spliced together. In either case they are handled and erected at the site as single pieces from about 25 to 150 ft. long, weighing from 5 to 90 tons.

The methods and appliances for girder erection are the same as those applied to the handling of the heavy members of much larger spans. They have been essential factors in the development of bridge erection as a whole, and are more and more being adapted for the simplification of complicated long-span erection. Their perfection has demanded and received the most careful study and the best efforts of engineers, the skill and experience of contractors, and the resources of manufacturers of special equipment.

GIRDERS ERECTED BY HAND METHODS

When wrought-iron spans first came into general use 60 or 70 years ago, these forerunners of present spans were built and erected with such simple appliances as were available for general purposes. Several distinct methods were adopted for unloading heavy girders and placing them on the substructure, all the work generally being done by hand. These means consisted of jacking and cribbing; rolling and skidding; and raising, lowering, and shifting with wooden gin poles, derricks, and single and double gallows frames. These were equipped with manila rope guys and tackles, rope and chain slings, and geared windlasses or "crabs" operated by two or four men.

Gin poles are round or square vertical timbers, usually from 20 to 50 ft. long with a timber foot-block and four or six guys. A four-, six-, or eight-part tackle is suspended from the top and operated by a hoist near by, or by a crab bolted to it near the foot. The single gin pole could only be used where it was possible to locate it near the center of gravity of the girder, which

CANTILEVER ERECTION OVER THE WABASH RIVER

was delivered alongside so that it could be unloaded and erected without shifting the gin pole. The top of the pole could be moved horizontally a few feet in any direction, according to its height, by slackening the guy ropes.

For heavy lifts, the guys were adjusted by tackles at the anchorages. If necessary, the girder was rolled or skidded from the unloading to the hoisting position and the gin pole inclined ahead to correspond by moving the foot along on a plank with pinch bars as the fore and aft guys were respectively taken up and slacked. In special cases the gin poles were king-post trussed on all four sides, or were made of four timbers, sometimes spliced, latticed, or battened together. Eventually, steel gin poles made of four angles latticed, and usually

TRAVELING TOWERS ERECT TWO LATTICED GIRDERS AT ONE TIME

tapering at both ends like steel derrick booms, became a part of the erector's stock plant. On occasion, two gin poles were used, one on each abutment; for example, where the girders were delivered between the abutments and a center gin pole would obstruct traffic on the low level.

Near Selinsgrove, Pa., two $82^1/_2$-ft., 17-ton girders of a highway span were recently erected by hand without any regular equipment except a small gasoline hoist, as shown in the photographs on page 349. The girders were shipped side by side and braced together, with their webs vertical, on two flat cars. Some distance from the site the webs were revolved into a horizontal position and the girders successively lifted by a pair of gin poles on to a

Three-Boom Derrick Car Transporting a 28-Ton Girder

four-wheel, rubber-tired trailer, on which they were hauled to the site. Light timber falsework between the abutments supported longitudinal beams, on which the girders were pulled across the river. They were then lowered a short distance to the abutments as their webs were revolved into a vertical position, after which they were skidded transversely to their final positions.

Gallows frames are essentially vertical bents with transverse framing, usually of timber, with vertical posts and horizontal caps knee-braced to them, and without a transverse sill. They are set astride a girder or a complete span with a clearance sufficient to raise or lower it and move it transversely or longitudinally by one or two tackles suspended from each cap. When single bents are used, they must be guyed; double bents well braced together become virtually towers, stable without guys. Gallows frames are simply and quickly constructed from materials universally available, and are easily installed and operated with a minimum of danger from inexperience or carelessness. Generally they were used in pairs at a high level, as illustrated, for unloading girders or spans

A Derrick Car and Locomotive Crane Replacing Trusses with Girders
Central Vermont Railway, at Georgia, Vt.

and for lowering them into position on the substructure. Their use often necessitated the delivery of the girders on falsework or on an existing bridge span in approximately the required longitudinal position.

Plate girders for replacing short-span bridges on the Baltimore and Ohio Railroad were delivered on flat cars, which were hauled across a falsework trestle replacing the original spans. The girders were shipped with their webs in a horizontal position. They were unloaded by pairs of tackles suspended from opposite ends of the gallows frame caps and attached to the top and bottom flanges at each end. They were hoisted several feet, the flat cars were removed, and the lower flange tackles slacked, so that the girders cleared the track as the webs revolved into a vertical position. The girders were then lowered to temporary positions until the trestle falsework was removed. Then the new girders were put in position in three minutes each, braced, and the track re-laid—all between trains.

Although gallows frames are still used where other appliances are not available, they are being superseded by powerful traveling derricks mounted on standard-gage railroad trucks, maintained as a part of the erector's regular equipment, and hauled wherever required as units of trains. Regular railroad wrecking cars, when available, offer a quick and powerful means of hoisting and lowering heavy girders. Although their reach is greatly limited, these cars can load and unload and

Derrick Car Unloading a 50-Ton Girder at Low Level

erect from tracks alongside the structure. If available in pairs, a wrecking car at each end of the girder can transport and set it into position from a single track.

As a further development the larger bridge erection companies built special steel derrick cars of greatly increased capacity, with folding masts and detachable booms so that they could be quickly dismantled for transportation in regular trains. The booms were long and strong enough to reach the center of gravity of most girders. The derrick would swing them to the center line of the track and transport them as far as necessary under its own power, thus being able to erect a span from one end without the necessity of falsework or other supporting structure. Some derrick cars were provided with auxiliary side booms, whose tackles, secured to the existing structure or other suitable anchorages on both sides, provided great transverse stability and enabled the boom to handle very eccentric loads safely.

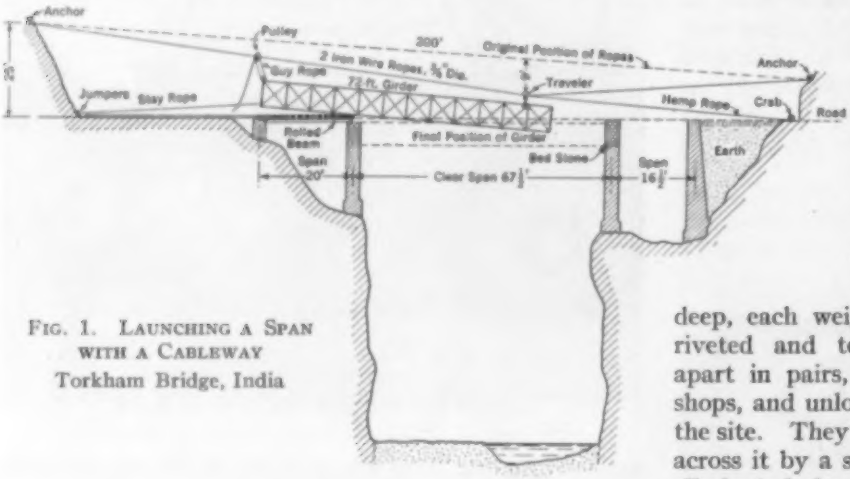


FIG. 1. LAUNCHING A SPAN WITH A CABLEWAY
Torkham Bridge, India

Locomotive cranes were used in the same manner as derrick cars, both by themselves, for light service, and to supplement the derrick cars. They were often employed to handle one end of a girder supported at or near the other end by a derrick car, which could support the greater part of the weight by adjusting its point of attachment. When caterpillar cranes with derrick booms and powerful hoists became popular and numerous in most parts of the country, they were used to handle girders of considerable weight and length in almost any locality; they are now included in every large bridge erection unit.

ERECTION WITH TRAVELING TOWERS

Many plate-girder and lattice-girder spans of as great a length as could be shipped complete from the fabricating shops were erected by a special equipment constructed to handle a pair of heavy girders simultaneously. On each of two independent, standard-gage trucks was installed a two-bent wooden tower a little taller than the depth of the largest girder. On the tower were seated a pair of transverse plate girders cantilevered about 10 ft. each side of the center. Vertical screw rods with hooks or clamps at their lower ends passed between the girders and engaged sliding saddle plates on the slightly inclined top flanges of the girders.

The towers were placed between the girders; the lower ends of the vertical rods were connected to the top members of the spans; and capstan nuts were operated on the screw rods to lift the girders clear of their supports. The girders were simultaneously lowered on the screw rods, and their saddles were moved outwards on the greased top flanges of the tower girders until the suspended spans were the proper distance apart. The trucks were pushed along the track until the girders were in the required position. They were then expeditiously lowered into place by slackening the capstan nuts. This special equipment and its operation are illustrated.

A four-span highway bridge 34 ft. wide, across the Wabash River, had 8 main plate girders 95 ft. long and 8 ft. deep, each weighing 20 tons. They were completely riveted and temporarily braced together 4 ft. 8 in. apart in pairs, loaded on flat cars at the fabricating shops, and unloaded by the contractor a half mile from the site. They were transported to the river and erected across it by a simple yet ingenious method that almost eliminated the erection plant usually required for such work.

The ends of the span were lifted alternately a few inches at a time by light jackscrews, and cribbing was built on the car floor under the center of the span. The span was rocked back and forth over the crib as a fulcrum, and each time the crib was raised a little until the span was far enough above the car floor to permit the attachment of rollers to the bottom flange of each girder. The special 10-in. rollers were made with oak blocks bolted between cast-iron hubs and bound with 9-in. steel tires $^3/_8$ in. thick. Each pair of rollers was attached to a transverse beam fastened to the lower flanges of the girders to provide a 25-ft. wheelbase under the center of the span. The span, held back by a preventer tackle, was skidded down a timber incline from the car to the ground by an anchored forward tackle operated by a steam hoisting engine installed on a platform on the span itself.

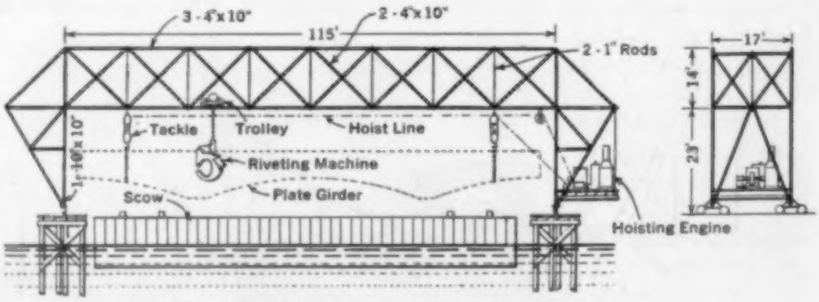


FIG. 2. RIVETING AND LOADING A SPAN OF THE HARVARD BRIDGE
Erection by Flotation, Charles River, Boston

At ground level the span was revolved on a turntable 7 ft. in diameter, with a $^7/_8$ by $^7/_8$-in. greased steel ring under the lower flanges of the girders, and secured to a timber bed. Tracks of 2 by 10-in. green maple planks were laid down in front as they were taken up behind, and over them the span was hauled by the tackle, which

was anchored to telegraph poles in advance and operated by the hoisting engine. With two pair of floor beams 34 ft. long (borrowed from the bridge itself) carried longitudinally between the girders, the span was moved forward until it cantilevered about 32 ft. beyond the abutment. There a falsework bent received the outer end of the first pair of floor beams when they were lowered to a support on it and on the abutment. These beams were then braced together to form a track on which the span, still carrying the other pair of beams, was hauled forward until it again extended 32 ft. beyond its support and overhung a second falsework bent awaiting it. The second pair of floor beams were then set on the two falsework bents to extend the track, on which the span was advanced until both ends could be lowered to bearing on cribwork on the abutments. The rollers, floor beam, track, and falsework bents were then removed.

The girders were jacked down to bear on greased transverse rails; the temporary bracing between them was removed; and the girders were slid 34 ft. apart. When they were lowered to their permanent bearings, the floor beams, stringers, and other steel completing the span, were assembled and riveted. The second, third, and fourth pair of main girders were unloaded and transported like the first pair, hauled across the finished span, and erected by the use of successive cantilever operations as described.

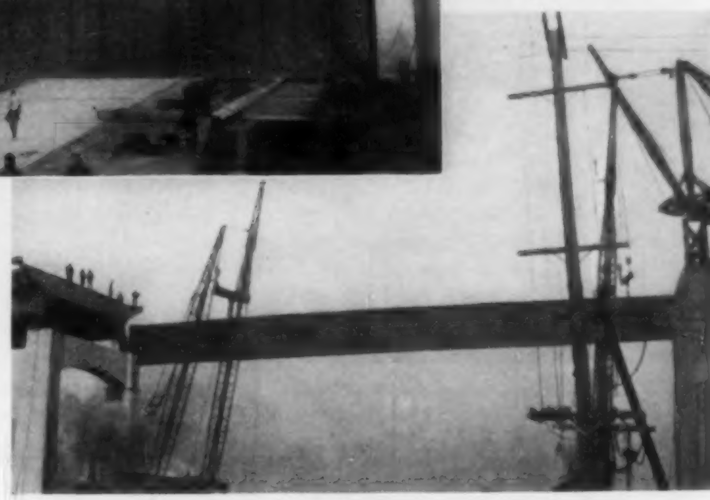
The time required for the erection of each span was as follows: unloading, hauling 150 ft., and revolving on turntable occupied 5 men for 15 hours; hauling one-half mile to the bridge site, 5 men for 18 hours; advancing the span from the abutment to the first pier, 10 men for 12 hours; lowering the span and suspending the floor beams, 5 men for 20 hours; and assembling and riveting the floor beams, 5 men for 15 hours. The total time required for one span was 460 man-hours. This work was executed approximately thirty years ago, when the labor cost of unloading and transporting was probably little more than $100. Today it would be at least $300, but the same work could be done in a few hours by four men and two caterpillar cranes.

ERECTING ON INTERMEDIATE CRIB PIER

A plate-girder span about 75 ft. long was erected on high stone piers in India by the aid of a temporary center support and compound track girders improvised from standard construction materials. This was in a remote mountain locality threatened by torrential floods, where timber and equipment were scarce.

During the low-water season, a massive temporary foundation pier of rubble masonry was built in the bed of the shallow stream and on it was laid 15 by 15-ft. cribbing about 50 ft. high, made with square railroad ties. Light I-beams laid on the cribbing and on the abutments supported a track over which the complete single-track deck span, loaded on two light flat cars, was pushed, about one-third of the span length overhanging the forward car. The span was jacked up to clear the cars and then jacked down to a support on the masonry piers. The cribwork and foundation pier were then removed.

At Torkham, India, two riveted trusses 72 ft. long were successively erected on shore



WRECKING CRANE, THREE LOCOMOTIVE CRANES, AND A STIFF-LEG DERRICK SETTING UP A 154-FT. GIRDER
Approach to the Maumee River Suspension Span, Toledo, Ohio

about 90 ft. above the water, and on the center line of the bridge, as shown in Fig. 1. The truss was on rollers at the shore end, and the top chord was connected at both ends to trolleys running on a pair of 200-ft. wire cableway ropes suspended above the truss and anchored to the rock at both ends. Each truss was launched separately and swung from one pier to the other by means of lines from the forward trolley to a hand windlass. It was then lowered a few feet to the required position.

GIRDERS ERECTED BY TRANSVERSE DISPLACEMENT

In January 1899, Bridge No. 75 of the Boston and Albany Railroad near East Brookfield, N.Y., a double-track 71-ft. Pony truss span, was replaced without interrupting traffic. The new span consisted of six plate girders 55 ft. long and about 6 ft. deep, which were completely riveted together on falsework bents at one side of the old structure. On the other side, falsework bents were also erected, at the level of the lower chord of the old structure, to receive it. New masonry abutments were built in front of the old ones to receive the shorter new span.

Both the old and the new spans were set on greased rails. Tackles operated by two derrick cars pulled the old span clear of its original position in about 6 minutes;

then the tackles were shifted to the new span, which was pulled over to occupy the place vacated by the old one. When halfway into position it was stopped, with the north track of the bridge in line with the south track of the railroad, to let a passenger train cross the river. The whole operation was completed in a total time of about 30 minutes. The workmen completed riveting the braces in the new structure while the bridge was in motion.

ERECTING CONTINUOUS GIRDERS WITH A STIFF-LEG DERRICK
Bayonne Bridge, Over the Kill van Kull, New York

The Harvard City Bridge across the Charles River, Boston, is made up of four lines of plate girders in 23 spans from 76 to 106 ft. long. The girders, after being riveted complete in the fabricating shops, were trucked to a storage yard equipped with a traveling gantry crane of 112-ft. span and 20-ft. clear height. They were suspended in pairs from the gantry (Fig. 2) while the transverse bracing was riveted to form complete spans. The spans were then deposited one at a time on a special scow moored between the gantry tracks, towed to the bridge site, and lowered to bearing on their piers by opening valves in the bottom of the scow. The scow was afterwards beached so that the water could be drained out at low tide, and the scow returned for another pair of girders.

ERECTING GIRDERS WITH DERRICKS

The Richmond approach to the great 1,675-ft. highway arch span completed in 1931 across the Kill van Kull, from Staten Island to New Jersey, has long plate-girder spans supported on lofty concrete piers. The girders in the 180-ft. span are continuous over one pier. They were shipped in two sections, the first of which was erected as a cantilever extending 56 ft. from the center of the pier. Some of the sections weigh as much as 81 tons. They were erected by a special all-steel stiff-leg derrick with an 85-ft. boom, a front reach of 73 ft., and a side reach of 27 ft. The traveler sills, 66 ft. apart, carried two transverse plate girders 5 ft. deep and 5 ft. apart. These girders, at the center, supported the mast and boom.

The sills were clamped to the top flanges of the girders after the traveler had advanced on them to the extremity of the 56-ft. overhang. From this position it hoisted each 124-ft. girder section, seated its forward end on top of the next pier, and maintained the rear end at the right height until the splice at the end of the cantilever section was field riveted. The girders were connected to the hoisting tackle by pairs of heavy plate hooks that engaged the top flanges. The hooks were suspended from the ends of a short spreader beam.

One of the approaches to the long suspension span of the highway bridge across the Maumee River, Toledo, Ohio, includes a 154-ft. plate-girder span with two 84-ton girders 12 ft. 1 in. deep and 43 ft. apart on centers. The girders, which are connected by floor beams 5 ft. deep, carry a heavy-duty concrete roadway 54 ft. wide. This is the longest plate-girder span on record.

Each girder, loaded on four flat cars, was delivered on a low-level track under the approach, and was unloaded by a 7-part hoisting tackle attached to the middle of the boom of a wrecking crane at track level. In 30 minutes the crane lifted the girder and swung it so that two 60-ton traveling cranes with 80-ft. booms, one at each end, could get it in position for hoisting.

At one end of the girder were two 60-ton low-level locomotive cranes, and at the other end were one 40-ton low-level crane and one high-level stiff-leg derrick on opposite sides of the girder. They hoisted the girder about 67 ft. and placed it on rocker pedestals with pin bearings. Each girder was unloaded, shifted, and set on its pedestals in less than an hour by ten men and a foreman.

As the length and weight of plate girders and trussed girders have been greatly increased during the last 60 years, different erection methods and equipment have been developed, which, in general, have superseded the older, slower, and more laborious ones. These last, however, may still be found advantageous under special conditions. In general, for standard work, manila rope and chain slings, and manila tackles; screw jacks; hand crabs; cribbing, wooden derricks, gin poles, and gallows frames, have been succeeded or supplemented by forged clamps, wire-rope slings, and tackles; hydraulic jacks; steam, gasoline, and electric hoists; and by traveling derricks, wrecking cars, derrick cars, locomotive cranes, and caterpillar-mounted derrick booms, respectively. The tendency now is toward the wider use of long-boom, heavy-duty steel derricks for girder erection. The result has been greatly increased speed and economy, simplified operations, more shop fabrication and less field work, reduction of hand labor, and more rigid and durable structures, with greater safety factors.

The Standard Theodolite of the U.S. Coast and Geodetic Survey

By William Bowie

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Theodolite Used by U.S. Coast and Geodetic Survey, in 1816
The Horizontal Circle Is 24 In. in Diameter

In 1688 there appeared a small book by John Love, entitled *Geodeasia: or, the Art of Surveying and Measuring of Land Made Easie.* At the end of the preface of his book, Love made the following statement:

"I have taken example from Mr. Holwell to make the Table of Sines and Tangents, but to every Fifth Minute, that being nigh enough in all sense and reason for the Surveyor's Use; for there is no Man, with the best instrument that was ever yet made, can take an Angle in the Field nigher, if so nigh, as to Five Minutes."

In less than 250 years engineers have developed theodolites from the crude instruments of Love's time to the Parkhurst instrument of today. Instead of having a limit of 5 min. of accuracy in the measurement of angles in the field, we now have instruments with which we can obtain an average closing error of less than 1 sec. for the triangles, and the correction to angles resulting from the adjustment of an arc of triangulation is seldom more than 1/2 sec. To realize how high is this standard of accuracy one has only to recall that the two sides of an angle of 1 sec. diverge only 1 ft. at a distance of 40 miles.

After many years of effort, the geodetic engineers of the U.S. Coast and Geodetic Survey have developed a theodolite that meets practically all their requirements. It was designed by D. L. Parkhurst, Chief of the Instrument Division, and in it are combined the best features of existing instruments and a number of new ones. A section of the base of the theodolite and the alidade are shown in Fig. 1.

Among the novel features is the double cone bearing of the vertical axis, the apexes of the two truncated cones being coincident. Because of this double cone bearing, the theodolite never binds with a change of temperature. It makes no difference whether the metal of the vertical axis and its socket have the same coefficient of expansion or widely different coefficients. This is a matter of very great importance because the average instrument, although it operates satisfactorily at a certain temperature, either moves too freely or binds if it is heated or cooled many degrees. In both cases the observer is badly handicapped, and his results may suffer in accuracy.

The double cone bearing for the vertical axis was first used in instruments nearly 40 years ago by E. G. Fischer, for many years in charge of the Instrument Division of the U.S. Coast and Geodetic Survey, but Fischer did not have the apexes of his two cones identical, although they were sufficiently close to each other to make for almost perfect movement of the alidade.

Another novel feature is the perforation of the vertical axis and the arrangements by which the various parts of the instrument can be illuminated with an electric current supplied by batteries set on the ground or on a platform under the instrument. This idea was entirely new at the time the instrument was designed several years ago. Some theodolites of foreign manufacture are illuminated by batteries detached from the instrument, but all the others with which I am familiar have small dry cells attached to the instrument itself.

Ball bearings are used in the tangent screw to prevent the dragging effect of the parts of the tangent device as the alidade is turned in azimuth. The tangent screw attachment was designed by Mr. Parkhurst in such a way that there is no tendency to lift the alidade as the screw is moved.

The horizontal and vertical circles have dustproof covers. These are very effective in preventing the marring of the graduations by sand and dirt, which are frequently very troublesome when the ordinary theodolite is used. The micrometer microscopes have a drum made of translucent glass on which the graduations are etched. An electric bulb within the drum furnishes light for the reading of the micrometer.

It is a long step from the 24-in. theodolite employed for geodetic surveys in 1816 to the neat 35-lb., 9-in. transit instrument developed and now in use by the U.S. Coast and Geodetic Survey. Even longer is the step from the best surveying instrument of the seventeenth century, reading to the nearest five minutes of arc, to the present theodolite, which will close triangles within one second of arc. In this article Dr. Bowie explains the outstanding features of the new standard transit instrument. Engineers engaged on such work as surveys for cities, subways, tunnels, and bridges will be glad to know that so much accuracy has been built into so compact a transit.

Besides illuminating the cross-wires of the telescope of the instrument and the drums of the micrometer microscopes, the electric wiring permits the illumination of the horizontal circle of the theodolite. There is no electric illumination of the graduations of the vertical circle. This is the only place a hand flashlight is needed.

STANDARD THEODOLITE OF THE U.S. COAST AND GEODETIC SURVEY
The 9-In. Circle Is Read with Two Micrometer Microscopes

The horizontal circle of the new Parkhurst theodolite is 9 in. in diameter and has graduations at intervals of 5 min. of arc. The readings are made to single seconds by means of two micrometer microscopes placed 180 deg. apart.

AN ACCURATE AND RAPID INSTRUMENT

With few exceptions, observations for the first- and second-order triangulation executed by the U.S. Coast and Geodetic Survey are made at night on electric signal targets. This gives a far longer observing period than can be had in daylight, and atmospheric conditions are generally superior. Day observations must be made on poles, targets, or on heliotropes; and it is very difficult to see a pole or target at a distance of more than five miles except when the atmosphere is extremely clear. Heliotropes can only be used when the sun is shining and then only during the late afternoon. The unsteadiness of the air is usually so great during most of the day that the sunlight reflected from the mirror of the heliotrope is either too dim or too unsteady for pointings.

While the U.S. Coast and Geodetic Survey has always secured a high degree of accuracy in its first-order triangulation, yet the geodetic engineers who have used various types of instruments favor the new Parkhurst theodolite over all others. The average closing error of the triangles for an arc of first-order triangulation is seldom more than 1 sec., and the maximum average for arcs in recent years is about 1.2 sec. The maximum allowable closing error of a triangle, in what is considered the strong chain of triangles of an arc, is 3 sec. Should any of these triangles have a closing error exceeding that amount, re-occupation of the stations involved in the triangles is made.

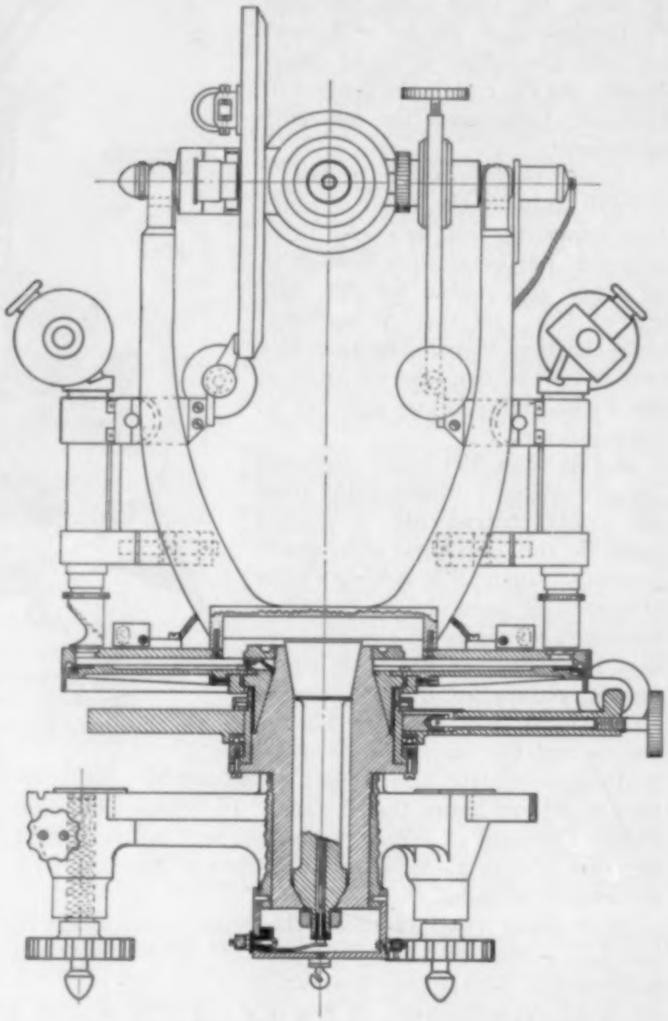


FIG. 1. SECTION THROUGH THE STANDARD THEODOLITE OF THE U.S. COAST AND GEODETIC SURVEY
Double Cone Bearing with Coincident Apexes

With the use of the Parkhurst theodolite some very rapid observing has been done. At a station in Alabama in 1930, Paul A. Smith, with one man besides the observer reading the microscopes, completed the observations in 40 minutes. There were 5 lines radiating from the station, and 32 pointings were made over each line. The determination of the direction in triangulation consists of the mean of the results from a pointing with the telescope direct, and from a pointing with the telescope reversed. It is thus seen that 16 determinations of the direction of a line are obtained. The average

deviation of the values for these 5 directions was only 0.86 sec. and the maximum was 2.57 sec. None of the measures of the directions had to be repeated, although 4 sec. is the limit of deviation allowed for a single measure from the mean of the 16 for any direction. In a number of cases the observations at a first-order station have been completed within an hour, and it is seldom that the occupation of a station requires more than two hours.

Of course, the time of observing at a station depends on a number of factors, of which the principal one is the experience and skill of the observer. Second in importance is the type of instrument used; and third, the condition of the atmosphere, whether it is steady or boiling. At times the atmosphere becomes very unsteady, so that it is difficult to point on the lights from the electric signal lamps. Another factor is the degree of brightness of the light from these lamps. If the atmosphere is hazy or smoky, lines from 15 to 20 miles in length are very difficult to observe on account of the dimness of the lights. Then there is one more factor, which is the strength of the wind. Except in mountainous regions, the instrument is raised from the ground on a wooden or steel tower; therefore, if the wind is strong, there is a certain amount of vibration in the tower, which slows up the instrumental work.

The first Parkhurst instrument was made at the headquarters of the U.S. Coast and Geodetic Survey, but other instruments have been made to order by manufacturers of surveying instruments in this country.

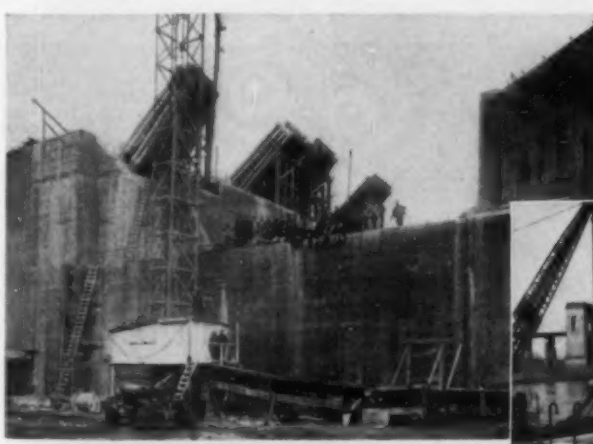
TOP OF A MODERN STEEL TRIANGULATION TOWER
Instrument Support and Observer's Platform Structurally Independent; Canvas Roof and Sides Protect the Observer

Geodetic engineers of the U.S. Coast and Geodetic Survey have tried out the very novel instruments of foreign make, in which one reading of the circles gives the position of the telescope for a pointing, but do not secure with them the excellent results that are obtained with the Parkhurst theodolite. These instruments have been used extensively in Europe, Canada, and some other countries, and there is no doubt but that they are useful in a region where transportation is exceedingly difficult and where the weight of the instrument is a prime factor. It is believed that a larger number of observations than are required with the Parkhurst theodolite would have to be made with one of them in order to secure results of like accuracy. The Parkhurst theodolite weighs only 35 lb., and when packed in its case it weighs only 75 lb.

The U.S. Coast and Geodetic Survey has made a smaller instrument of the Parkhurst type with a horizontal circle only $6^1/_2$ in. in diameter. It is expected that this instrument will be used extensively by the engineers of the Survey on second- and third-order triangulation. In an emergency, it could be used on first-order work, but undoubtedly many more observations would have to be made with it than with the 9-in. theodolite, in order to secure the desired accuracy.

Progress on the Triborough Bridge, New York

Progress has been made in the work on the $32,000,000 Triborough Bridge, connecting the Boroughs of Queens, the Bronx, and Manhattan. On the 1,380-ft. suspension span across Hell Gate, between Queens and Ward's Island, the anchorages and the foundations of the two towers supporting the cables have been completed. The view of the massive concrete anchorage on Ward's Island during construction, shows the eyebars used for the cables. On page 933 of the July 1931 issue of CIVIL ENGINEERING appeared a photograph of the model of this structure. The bridge, which will be a toll structure, is being built by the Department of Plant and Structures of New York City, of which Edward A. Byrne, M. Am. Soc. C.E., is the Chief Engineer.



WARD'S ISLAND ANCHORAGE, LOOKING NORTHWEST

ASTORIA ANCHORAGE NEAR COMPLETION, JANUARY 1932

Picturing the Structure of the Wind

Experiments at the University of Michigan Determine Characteristics of Gusts

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Continued interest in the subject of wind pressures on engineering structures induced the National Electric Light Association to sponsor and finance a research investigation on the subject by the Engineering Research Department of the University of Michigan. The experimental methods adopted include a study of the duration, intensity, and extent of wind gusts. A description of the equipment and methods used and preliminary samples of the results so far obtained, in the form of iso-velocity contour charts, are made available in this article. With special electric recording anemometers, mounted at the top of 50-ft. poles and at vertical intervals of 50 ft. on a 250-ft. steel tower, simultaneous readings of velocity give data from which iso-velocity contours are plotted. The contours reveal in the moving air invisible vortexes and sinks, which in water are easily observable. It is believed that this method is unique for investigating and depicting the structure of the wind over an extended area.

Tests at the University of Michigan in measuring and depicting the structure of wind gusts are part of a general research project on the loading and strength of overhead electric power lines, which is being sponsored and financed by the National Electric Light Association. The research work is being carried on in the Department of Engineering Research of the University of Michigan. A preliminary report of the results of the general project was published in the National Electric Light Association Bulletin for January 1931.

In order that the results obtained in the main part of the investigation might be adequately analyzed, it was necessary to undertake a supplementary investigation which would show the intensities, duration, and extent of the wind gusts that occur during storms at the site of the experimental power line.

The site of the experimental station is near Ann Arbor, Mich., on a ridge of land the axis of which is approximately normal to the prevailing storm winds. The windward side of the ridge has a gentle slope of about 175 ft. in four miles, and contains occasional farm buildings and groves of trees. The nearest obstruction is a grove at a distance of about $^3/_8$ mile and at such an elevation that the tops of the trees are level with the top of the ridge.

Anemometers and Plant Arrangement

At the beginning of this project three anemometers were installed for the purpose of obtaining records of wind velocities at points along the experimental line. Two of the anemometers were modifications of the Dines pressure tube, and one was a revolving three-cup anemometer of the standard type used by the U.S. Weather Bureau except that it was equipped to record each $^1/_{60}$ mile instead of each mile of passing wind.

A study of the records of these anemometers led to the conclusion that, because of the inertia of the moving parts of the instruments, the records could be accepted as accurate only if they were averaged over an interval of 10 sec. or more. This degree of responsiveness was satisfactory for some purposes of the main investigation, but it was not sufficient to disclose the characteristics of the passing gusts. For example, in the case of a wind gust having an average velocity of 60 m.p.h. (miles per hour), the gust would have traveled 880 ft. in 10 sec., but the instruments would have yielded no information as to the intensity, duration, or extent of the peak velocities occurring within it. It was decided, therefore, to develop an anemometer which would record accurately the average velocity for intervals of time as small as $^1/_2$ or $^1/_4$ sec.

The type of instrument which was finally developed consists of a pressure plate 9 in. high and 8 in. wide, which is hinged near the bottom so that pressures against the plate are transmitted by a pusher rod to a magnetic transmitter. The wind pressure changes the air gap of the transmitter, thus controlling the amount of current passing through its coil. The current is recorded by a 12-element oscillograph, which permits the taking of simultaneous records from 12 anemometers.

The pressure plate has a maximum movement of about 0.005 in. and a natural frequency of vibration of about 115 cycles per second. About 0.12 sec. is required for the instrument to complete its response to an impulse against the pressure plate and be ready to receive a new impulse

Inside the Chart House, Showing Oscillograph
Pressure-Plate Anemometer Data Are Recorded Electrically

without interference in the records. Tests were made on the anemometers to determine the amount of error that may be introduced in the readings by various causes. It was found that the limit of error due to temperature effects is 0.27 m.p.h.; that due to imperfect leveling, 0.45 m.p.h.; and that due to changes in the angle of incidence of the wind, 1.25 m.p.h. A complete description of the anemometer and its recording instrument was published in the Engineering Research Bulletin No. 20 of the University of Michigan, May 1931. A photograph of one of the anemometers is shown.

Another illustration shows the arrangement of the steel tower and the 50-ft. wooden poles that are used to support the anemometers and direction recorders. The poles are spaced 60 ft. apart and the tower is 250 ft. high, with stations at 50-ft. intervals. From this arrangement it is possible to obtain a horizontal section of a passing gust at a height of 50 ft. above the ground and over a front of 660 ft. If 4 of the 12 anemometers are placed at the upper stations of the tower instead of on the wood poles, it is then possible to obtain simultaneously a horizontal section and a vertical section of the passing gusts. This latter arrangement is the one that was used in the observations discussed in this paper. A wind-direction indicator was mounted at each of 5 stations on the 50-ft. poles.

DEPICTING THE WIND GUSTS

For the purpose of match-marking, the records of every storm are divided into runs of from 6 to 12 min. each. About 350 such runs have been made since the start of the project, but it was not until the winter of 1930–1931 that the new-type anemometers were ready to have their records included in these runs. The wind gusts discussed in this article occurred near the middle of Run 330 on the afternoon of April 28, 1931.

Diagrams were prepared from the records for the purpose of showing graphically the variations in the velocity of the passing wind. A part of such a diagram is given in Fig. 1, which shows the variations that occurred in a horizontal and also in a vertical plane during an interval of 47 sec. The spacing of the anemometers was used as the ordinates and time as the abscissas. The time was divided into intervals of $^1/_2$ sec., and the average wind velocity in miles per hour was recorded for each interval at each anemometer. Contour lines were drawn so that any given line represents a particular velocity and passes through only those intervals in which that particular velocity was indicated by the anemometers. These lines, which will be referred to as iso-velocity lines, indicate by their spacing the rapidity with which the velocity is changing.

A well defined wave front of a gust appeared at Station 6 during the last part of Second 344, and spread to all the horizontal stations within the next 6 sec. After the wave front had passed, the gust maintained a high average velocity at all stations with, however, rather steep gradients of velocity appearing in some places. For example, during Seconds 362 and 363 the wind velocity at Station 3 increased from 35 to 51 m.p.h. in 1 sec., that is, with a velocity gradient of 16 m.p.h. per sec. At this point there is a zone of low velocity closely followed by a zone of high velocity. It will be seen that this type of configuration appears frequently in the diagrams, and later discussions will show that it is similar to the configurations of the iso-velocity lines in some theoretical cases of air flow.

It is interesting to note that the front of the gust reached the upper stations on the tower several seconds before it reached those at the 50-ft. level, and that a strikingly symmetrical eddy occurred near the top of the tower immediately following the wave front of the gust.

ARRANGEMENT OF EXPERIMENTAL STATION
Pole Anemometers Give a Horizontal Section, Tower Anemometers a Vertical Section, of the Wind

These conditions are very similar to those which existed at the beginning of an earlier gust in the same run, as shown in Fig. 2, except for the position of the zone of high velocity in relation to that of low velocity.

The recurrence of certain orderly configurations of the iso-velocity lines makes it apparent that many of the eddies in this turbulent mass of air follow approximately some regular law. Iso-velocity lines for several theoretical cases have been worked up for the purpose of throwing some light on the nature of the turbulent flow in the free air, as disclosed in these gusts. Two such theoretical cases are shown in Figs. 3, 4, and 5.

In Fig. 3 are shown the stream lines and iso-velocity lines near a vortex whose center is traveling at the rate of 30 m.p.h. The strength of the vortex is such that at a distance of 50 ft. from its center the peripheral velocity is 2 m.p.h. The resultant velocity at any point is obtained by taking the vector sum of the two component velocities. In the upper half of the diagram the direction of the peripheral velocities is such as to increase the velocity of translation, while in the lower half the peripheral velocities oppose the translation. As a result, there is a

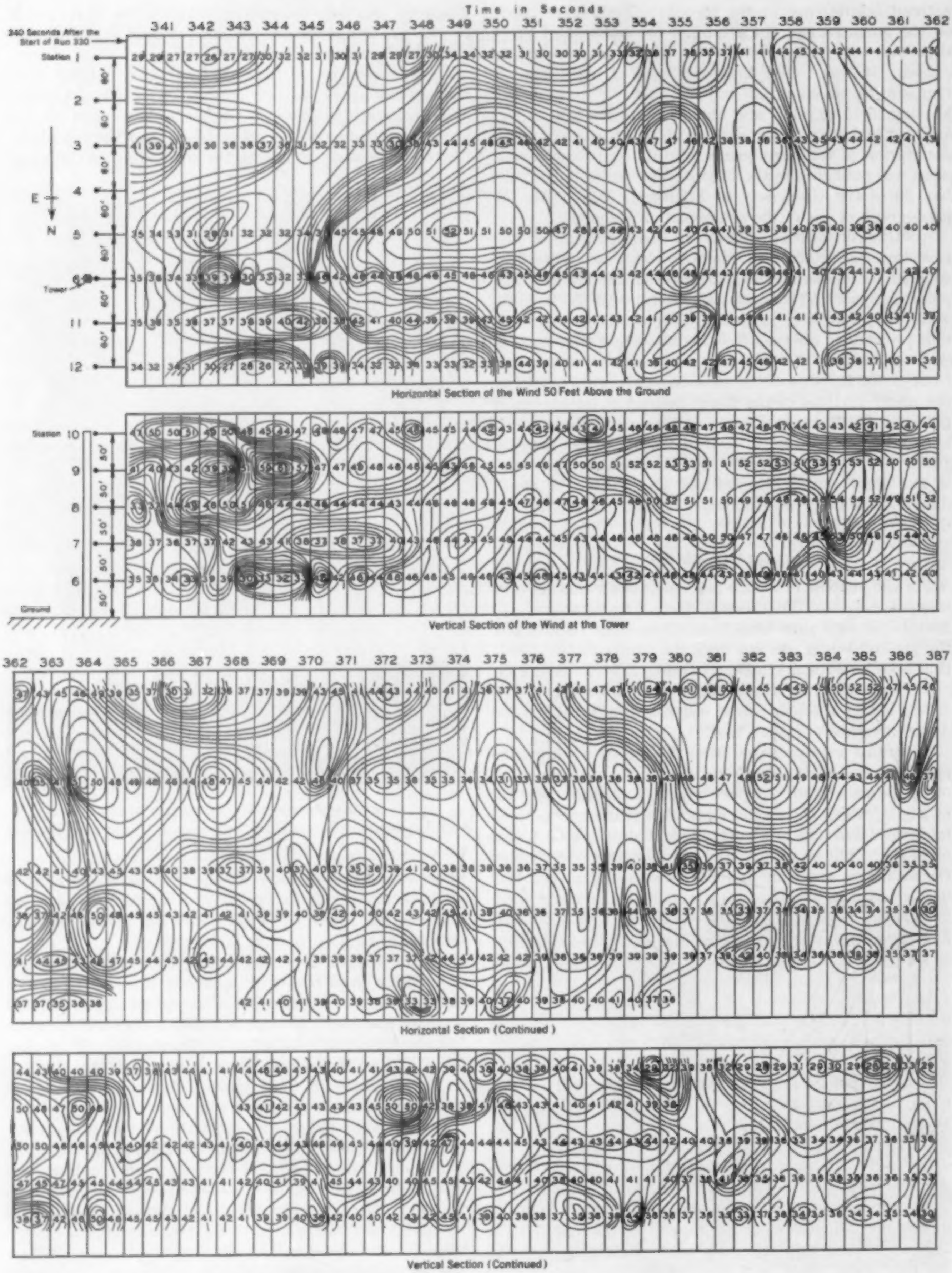


FIG. 1. WIND GUST DEPICTED BY ISO-VELOCITY LINES
Each Number Is the Average Wind Velocity in M.P.H. for the Half-Second Interval in Which It Is Shown; Prevailing Wind West

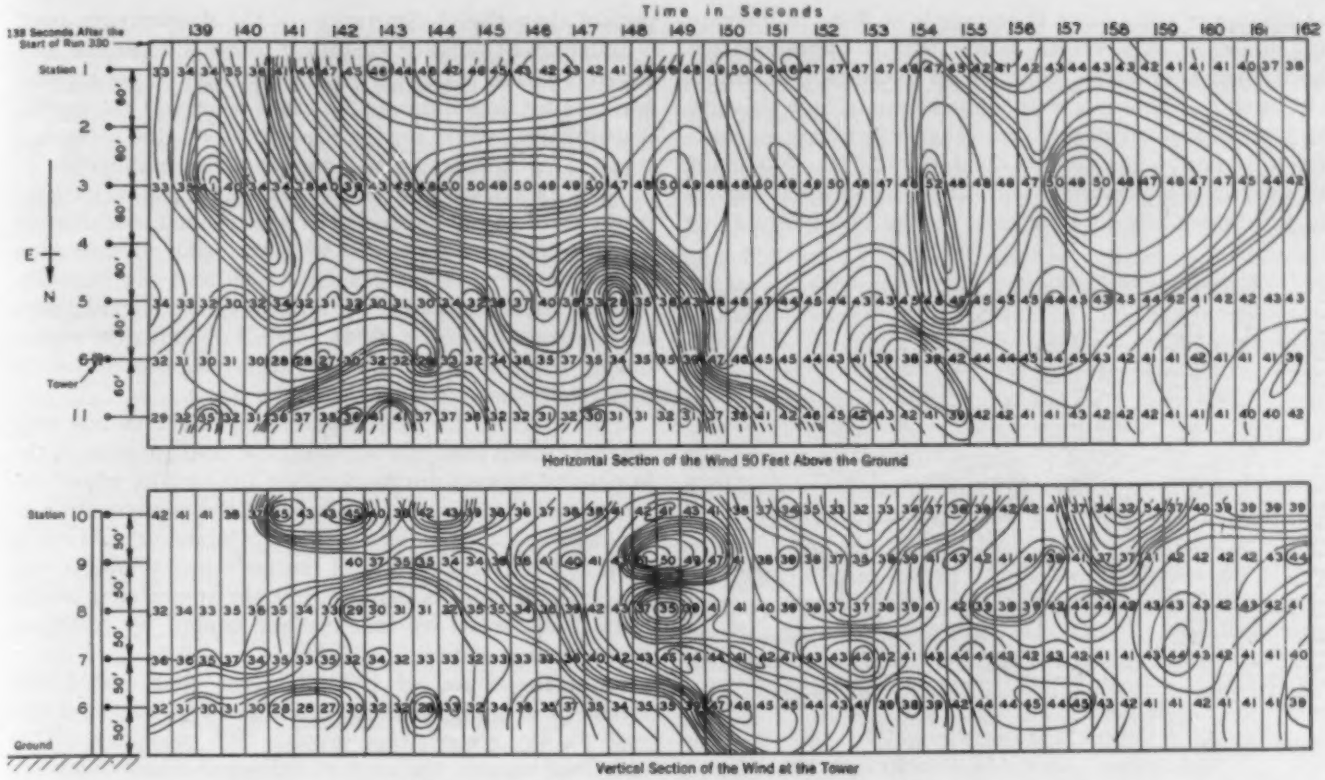


Fig. 2. Iso-Velocity Lines in Part of a Wind Gust

zone of high velocity in the upper half of the diagram and a zone of low velocity in the lower half, with a very steep velocity gradient between the two zones. Since one of the characteristics of a vortex is that the peripheral velocities increase toward the center inversely as the radius, there is theoretically a point at which the peripheral velocity is just equal to the velocity of translation, giving, in this case, a point of zero velocity a short distance below the vortex center. Between this point and the vortex center the resultant velocity is theoretically in the opposite direction to the velocity of translation.

As the velocity increases toward the center of the vortex there is a decrease in the static pressure, and consequently a tendency for the air to rush into the open ends of the vortex cylinder and to form sinks, as illustrated in Fig. 4. In a perfect gas, that is, in a non-viscous fluid, it would be impossible for a vortex to maintain its shape unless the ends of the vortex cylinder were closed by a boundary. In the natural air there is sufficient viscosity to slow down the disintegrating process and to permit the vortex to maintain itself by losing at its circumferential boundary an amount of air equal to the volume which flows into the ends of the cylinder.

It was assumed that the peripheral velocities varied inversely as the radius, as in the case of a theoretical vortex. The partial longitudinal section shows the flow into the end of the vortex cylinder due to the decrease in static pressure as the peripheral velocities increase toward the center. The dotted lines indicate the convergence of the stream lines as they pass R, the plane of reference that was used to obtain the stream lines and iso-velocity lines of the sink shown in Fig. 5. The parallelogram of velocities in the upper left quadrant of the cross section shows the method of combining the peripheral velocity with the velocity of translation to obtain the resultant velocity at any point for use in the construction of Fig. 5.

Stream lines and iso-velocity lines for the theoretical case of an aerodynamic sink traveling at the rate of 30 m.p.h. are shown in Fig. 5. The velocity of translation is parallel to the plane of reference R, but the velocities in the sink converge from all directions to a center, which in this case is 10 ft. away from the plane of reference. The strength of the sink is such that about 30,000 sec-ft. of air disappear at its center. The stream lines and iso-velocity lines were obtained by taking the components of the velocities in the sink as they passed the plane of reference, and combining them vectorially with the velocity of translation in the plane.

Each of the theoretical cases described has a zone of high velocity and a zone of low velocity. In the case of the vortex, the two zones are side by side in the stream, but in the case of the sink the high zone follows the low zone. In both cases there is a steep velocity gradient between the two zones. In the case of the sink, the high zone tends to envelop the low zone, the amount of this enveloping tendency depending upon the relative strengths of the sink and the uniform flow.

THE VORTEX AND THE SINK IN A NATURAL WIND

The cases of the vortex and the sink are easily observed in water because the direction and velocity of flow are discernible. In the case of water flowing out of a kitchen sink, the characteristics of both a vortex and a sink are present. In a natural wind, however, these phenomena are not visible, and they can be disclosed only by measurements of velocity or pressure.

Referring again to Fig. 2, Seconds 147 to 150, it will be seen that the configuration of the iso-velocity lines

at the upper stations of the tower is such as to indicate the presence of a vortex whose axis is approximately horizontal and whose direction of rotation is counterclockwise. There is a well defined zone of high velocity and one of low velocity with a velocity gradient amounting to 16 m.p.h. in a vertical distance of 50 ft. No doubt this vortex is generated by the difference in the velocities of the upper and lower strata, as the lower strata lag behind the upper because of friction with the ground and the viscosity of the air.

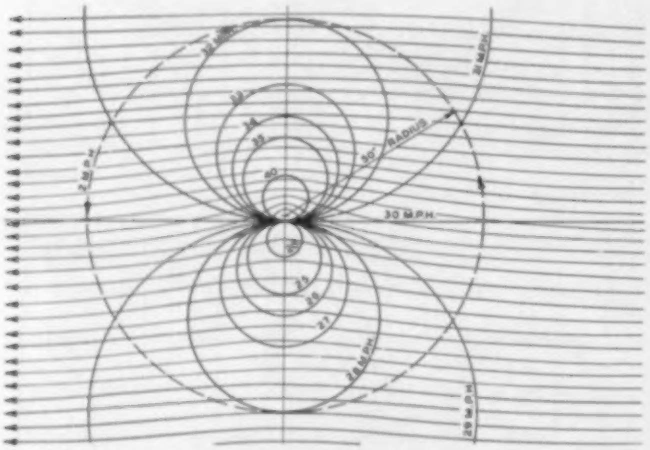


FIG. 3. A VORTEX SUPERIMPOSED ON UNIFORM FLOW With Stream Lines and Iso-Velocity Contours

A well defined sink, which appeared at the upper stations of the tower during Seconds 341 to 345, is shown in Fig. 1. Here the zone of high velocity follows that of low velocity in the wind stream, and a very steep velocity gradient exists between the two zones. The tendency for the high zone to envelop the low zone is more pronounced here than in the theoretical case shown in Fig. 5.

Attention is called to the similarity of the configurations shown in the horizontal section during the intervals of Seconds 152 to 156, 356 to 360, 362 to 366, 371 to 375, and 386 to 387. This type of configuration seems to be a composite of a vortex and a sink. Such a condition might exist in the case of a vortex whose axis was very nearly vertical and whose lower boundary was near the horizontal plane of reference. Under this condition the horizontal section near the bottom end of the vertical vortex cylinder might include the components of the upward velocities of the inflowing air as well as the peripheral velocities of the vortex. However, this assumption does not explain the presence of the double zones of high velocity which occur in Seconds 154 to 162 and 362 to 369.

The eddies in the wind stream are constantly undergoing changes due to collision with other eddies. It is quite reasonable to expect that the theoretical cases will rarely be reproduced perfectly in the natural wind. Furthermore, this method of measuring and recording the structure of wind gusts shows the shape of the eddies as they pass the line of anemometers and not as they exist in their entirety at any instant. If, therefore, an eddy starts to disintegrate just as its boundary reaches the anemometers, the configuration of the iso-velocity lines in the upstream part of the eddy will be more imperfect than the configuration in the downstream part.

Indefinitely smaller turbulent masses could be discovered within the larger masses by using closer spacing and smaller time intervals, but it is believed that smaller disturbances would not be significant in this investigation. It is interesting to note that the combination of 50 and 60-ft. spacing of the anemometers with time intervals of $^1/_2$ sec. is about the least refined combination which could have been used without losing all indication of the nature of the turbulent areas that are here disclosed. If, for example, the spacing of the anemometers on the tower had been 100 ft. instead of 50 ft., the vortex during Seconds 147 to 150 would have appeared merely as an irregularity in the iso-velocity lines.

The effect of the collisions of the larger eddies with smaller ones is seen by comparing the configuration in the horizontal section during Seconds 362 to 366, where the anemometer spacing is 120 ft., with the configuration in Seconds 371 to 376, where the anemometer spacing is 60 ft. The configuration of the iso-velocity lines in the latter disturbance is definite, but the smoothness of the lines is disturbed by indentations caused by collisions with smaller eddies.

After the winter of 1930–1931 the chart speed was increased in order that time intervals of $^1/_4$ sec. might be used on any records that involve high velocities. This was done because the type of turbulent areas which are barely disclosed in the records here shown, with average velocities between 35 and 40 m.p.h., would be completely lost in records with higher average velocities unless the length of the time intervals is decreased as the velocity increases.

ADVANTAGES OF ISO-VELOCITY CONTOURS

The use of iso-velocity lines to depict the structure of wind gusts has the following advantages: (1) From an inspection of the diagram it is easy to determine the velocity gradients at different points along the line of the anemometers; (2) at any given point the manner in which the velocity gradient varies with time may be determined; (3) by comparing the configuration of iso-velocity lines in the diagram with the configurations in theoretical cases it is possible to determine the characteristics of the turbulent motions and thus to extend the conclusions which may be drawn from the records; and (4) the velocity gradients, either along the line or along the wind stream, may be quickly converted into pressure gradients.

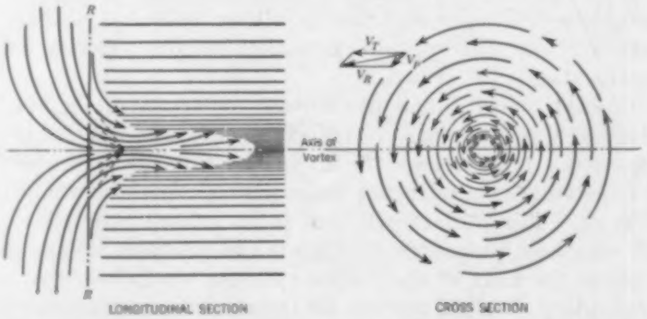


FIG. 4. CHARACTERISTIC FLOW IN THE PRESENCE OF A VORTEX Depicting Flow Into Vortex Cylinder and Inclination of Stream Lines at Plane of Reference R

In the field of structural engineering, diagrams such as these will be useful in determining the magnitude and extent of the impact effects of wind gusts. For example, at Station 5 during Seconds 344 and 345 there is an increase in velocity from 34 to 45 m.p.h. occurring in 1 sec. This effect appeared also at Station 6. If the coefficient for flat plates is used to obtain the corresponding wind pressures, they would be, respectively, 3.8 and 6.7 lb. per sq. ft., an increase of 75 per cent in 1 sec. over a front of more than 120 ft.

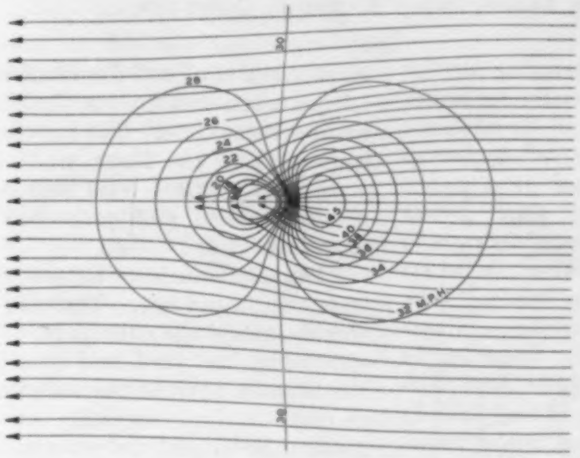


Fig. 5. A Sink Superimposed on Uniform Flow
Stream Lines and Iso-Velocity Lines at Plane of Reference *R* in Fig. 4

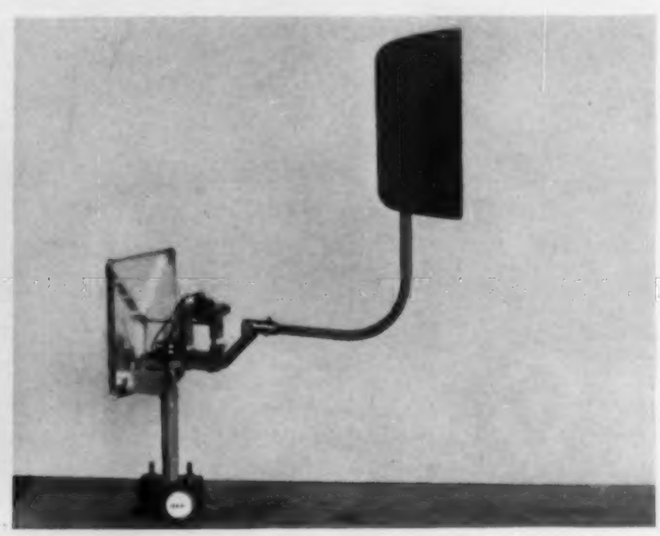
The dynamic effect is even more pronounced in the cases of the vortex and the sink. In the latter case, during Seconds 342 to 344 at Station 9, the velocity rose from 39 to 59 m.p.h. in 1 sec., giving a change of pressure from 5.0 to 11.5 lb. per sq. ft. in 1 sec. This is an increase in pressure of 130 per cent in 1 sec., but the area over which it acts is much smaller than in the case previously cited. In the case of the vortex during Seconds 147 to 150, the velocity at Station 8 is 35 m.p.h. when the velocity at Station 9 is 50 m.p.h. The corresponding pressures are 4.0 and 8.2 lb. per sq. ft., giving an increase of pressure of 105 per cent in a 50-ft. increase in height. Unfortunately, the most favorable height for the formation of vortexes at this site seems to lie between 150 and 250 ft., so that the length of the vortexes along their own axes could not be disclosed without the use of additional towers.

Many attempts have been made in the past to obtain quantitative information in regard to the structure of the wind. All these attempts have been limited in their scope and accuracy by the instruments available to the investigators. One of the most recent and most successful investigations of this kind was conducted by Dr. Wilhelm Schmidt and reported in *Sitzungsberichte, Akademie der Wissenschaften*, Vienna, 1929. By taking motion pictures of a line of pendulum plates and observing the angles through which they were deflected, he was able to determine the average wind velocities existing at the various plates for intervals of time as small as a fraction of a second, if the wind velocity did not exceed 10 m. (meters) per sec. (22.4 m.p.h.). The length and height of the front over which observation can be made in this way are rather limited. The purpose of his investigation was served by taking simultaneous records for a height of 1.5 m. and a width of 3 m. in one case, and for a height and width of 10 m. in another case.

Only a very small part of the wind records from the new anemometers has been worked up thus far. It is intended that eventually a number of selected runs should be prepared in diagrammatic form so as to disclose the characteristics of the gusts that occur during wind storms whose intensities make them significant in this investigation.

All the wind records will be subjected to statistical analysis for the purpose of correlating peak velocities, that is, the average velocities over small intervals of time, with 5-min. average velocities. This will make it possible to correlate the results with the long-time records of the U.S. Weather Bureau, where the wind velocity is expressed in terms of the average for 5-min. intervals. Thus, although the main purpose of this investigation is the study of the loading and strength of the aerial structures in electric power lines, it is expected that the incidental information regarding wind gusts will be made available in such form that it will be useful to those engaged in structural engineering, aeronautics, and possibly in other fields.

Pressure-Plate Anemometer Installed on Tower Station



Cover Removed to Show Magnetic Transmitter

Cleveland's Cooperative Food Terminal

Nickel Plate Railroad Builds Facilities for Local Commission Merchants

By Wilbur J. Watson
Member American Society of Civil Engineers
Senior Partner, Wilbur Watson and Associates, Architects and Engineers, Cleveland

For the purpose of bringing together into a central location the perishable food industry of Cleveland, the wholesale commission merchants of that city formed an association, organized as a public utility. Forced out of their former district by the construction of the recently completed Cleveland Union Passenger Terminal, they selected a new site with appropriate railroad facilities and convenient outlets for city deliveries by truck. This Northern Ohio Food Terminal project was financed and built by the Nickel Plate Railroad, under a contract by which each merchant eventually will own his particular unit. Yards and trackage are provided by the railroad. The gross investment represented in the terminal project is approximately $6,000,000. At least 90 per cent of the fruit and vegetables coming into Cleveland were handled by its members at the time the corporation was formed.

In order to build Cleveland's new Union Passenger Terminal, described in Civil Engineering for November 1930, it was necessary to acquire considerable property occupied by various wholesale commission merchants. In fact, so large a part of the wholesale commission district was required that the district was practically destroyed. While the Union Terminal development was in the planning stage, therefore, the commission merchants were faced with the problem of moving to new quarters, and it was at this time that interests connected with the Nickel Plate Railroad conceived the idea of centralizing the business in an entirely new district.

The railroad went about the project quietly and bought up a large tract of low-grade residential land adjacent to its right-of-way at a point very close to the geographical center of population of greater Cleveland. When this was accomplished, an invitation was extended to the commission merchants of the city to form themselves into an association for the purpose of developing a new wholesale produce center, the Northern Ohio Food Terminal with adequate facilities to serve Cleveland and northern Ohio. The merchants responded to the idea; and their committee secured legal and engineering advice and proceeded to negotiate terms.

The basic principles agreed upon were simple and fair. The railroad would assume the entire cost of developing the yard and trackage, would turn over to the merchants, at cost, the land necessary for the market area and its streets, and would underwrite the buildings and improvements. It consented also to absorb in the yard costs all legal and engineering fees. For their part, the merchants agreed to form a company and construct the buildings and improvements, and to guarantee the down payments, interest, and amortization due the railroad. On this basis the Northern Ohio Food Terminal, Inc., was formed and the project bearing that name was planned and constructed. At the time it was incorporated, its members were handling over 90 per cent of all the fruit and vegetable shipments coming into Cleveland.

Northern Ohio Food Terminal, Cleveland
Unit No. 1 in Foreground; Unit No. 2 in Background

The location selected is served directly by the Nickel Plate Railroad and admits of convenient connections with most of the other railroads entering Cleveland. To all these railroads it is open on the basis of a fixed charge per car. The tract purchased comprises approximately 33 acres lying between East 37th and East 40th Street, adjacent to Woodland Avenue. Its location in relation to greater Cleveland may be seen from Fig. 1. East 40th Street and Woodland Avenue are two of the main trucking thoroughfares of the city.

The project was financed by the Nickel Plate Railroad interests through a subsidiary, the Nickel Plate Development Company, which furnished the funds for construction purposes. On behalf of the Northern Ohio Food Terminal, Inc., the elected board of directors of that corporation controlled the planning of the layout of buildings and streets and the working out of the terms of the subscription agreement by which each member undertook to carry his share of the cost of the project.

As soon as general plans for the buildings were decided upon, members of the association chose their locations by lot, each taking from one to four units, according to the size and needs of his business. Certain changes were then made to accommodate individual owners, such as omitting elevators and changing partitions, but nothing was done that would make it impossible to revert strictly to the original typical 20-ft. unit at such time as this might be found desirable for any reason.

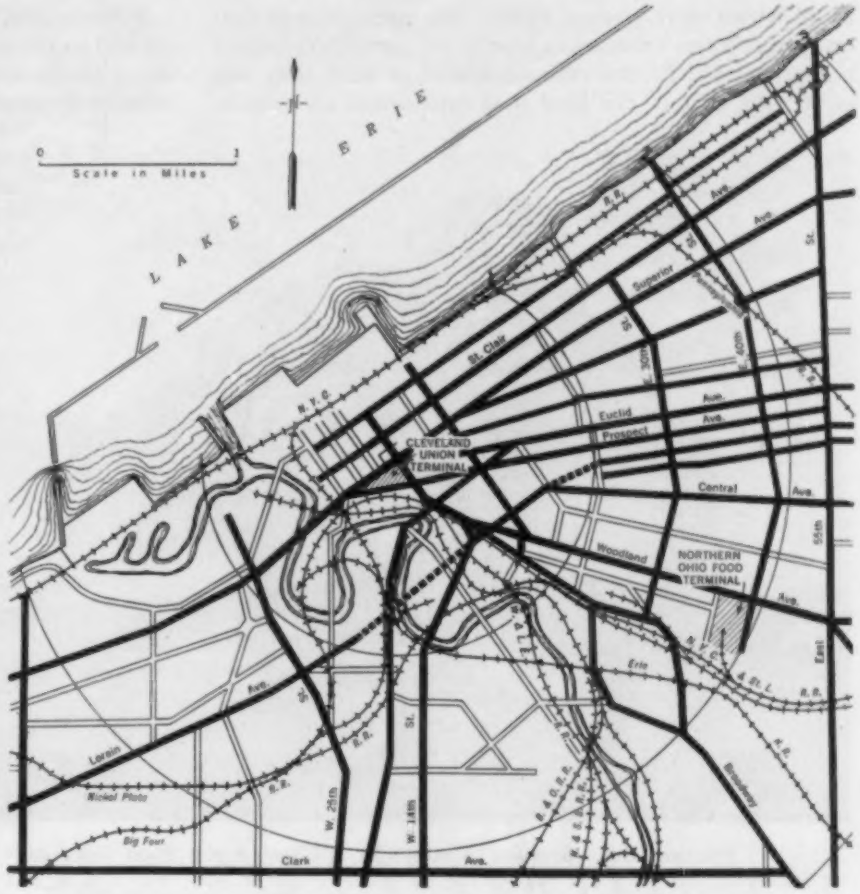


Fig. 1. Location of the Northern Ohio Food Terminal in Cleveland
The Commission Merchants Originally Occupied the Area on Which Cleveland's New Union Passenger Station Stands

After these changes were incorporated in the drawings, careful cost estimates were prepared, and on these were based the subscription agreements between the Northern Ohio Food Terminal, Inc., and its member tenant-owners,

Auction Building with Two-Story Section for Offices
Northern Ohio Food Terminal

all of whom were treated exactly the same, except that an agreed bonus value was added to the computed costs of corner units. To the estimated cost of each unit was added the cost of the land it occupied and its proportionate share of the joint streets and their improvement. To the sum thus obtained was added a flat 10 per cent as a buffer to care for the possible over-run of estimates and to provide a fund for joint operation and contingencies.

FEDERAL COLD STORAGE WAREHOUSE, A UNIT OF THE FOOD TERMINAL

Each tenant, on signing his agreement to become a member in the undertaking, was required to deposit 2 per cent of the value of his unit or units and 8 per cent additional on notice that his space was ready for occupancy and leases ready to execute. All leases were drawn for 99 years, renewable forever, and were computed on the basis of 6 per cent interest and amortization in 20 years. All lessees bind themselves to assume their own taxes and their proportionate share of maintenance and upkeep, and to abide by the rules decided upon from time to time by their own elected board of directors.

PLAN PROVIDES COMPLETE SERVICE

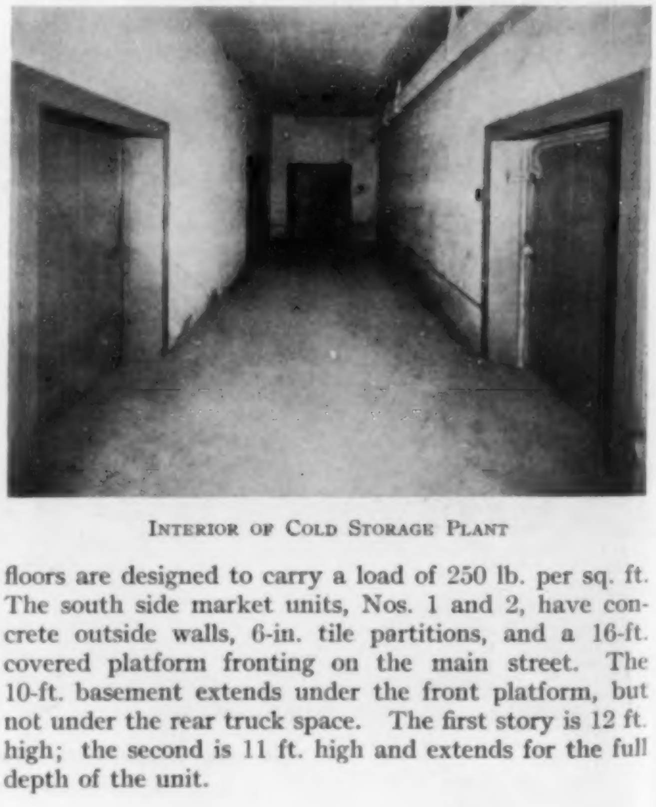
In general, the project provides four main market unit buildings, paved yards with a capacity of 410 cars, an auction house, and a cold storage plant on the site, the last mentioned being a separate enterprise. The main market street, laid out at right angles to the yard tracks and drives, is 110 ft. wide and 1,020 ft. long, and is intersected, at about the center of the area, by a street 60 ft. wide. The market buildings that front on the main street are arranged in four blocks, each block consisting of similar 20-ft. units, as shown in Fig. 2. Those to the south of the main street (Units 1 and 2) have basements and two stories, and those to the north (Units 3 and 4) are one-story buildings, with basements under only part of their areas.

At the rear of the northerly units there is a 40-ft. street parallel to the main market street and extending the full width of the area. At the rear of the southerly units, between them and the ends of the yard tracks, there is a 60-ft. street tying together all the yard driveways. The market section has an area of 408,000 sq. ft.; the yard occupies about 550,000 sq. ft. and has about 21,000 lin. ft. of trackage, all served by concrete drives of ample width.

In the western part of the yards there is a large modern auction shed with a two-story section containing the auction room, offices, and a restaurant. Adjacent to this is a cold storage plant occupying a ground area of 58,000 sq. ft. and having a gross storage capacity of 2,880,000 cu. ft. In the southeastern part of the yard is a covered area used as a farmers' or growers' market.

Around the entire area, including the yards and the market sections, is an 8-ft. woven wire fence with gates conveniently placed for entrances and exits, so that the entire district is under control for regulating hours of business and for economical policing.

Typical units are 20 ft. wide and 100 ft. deep, including a 22-ft. enclosed truck space at the rear. In general, the floors are designed to carry a load of 250 lb. per sq. ft. The south side market units, Nos. 1 and 2, have concrete outside walls, 6-in. tile partitions, and a 16-ft. covered platform fronting on the main street. The 10-ft. basement extends under the front platform, but not under the rear truck space. The first story is 12 ft. high; the second is 11 ft. high and extends for the full depth of the unit.



INTERIOR OF COLD STORAGE PLANT

Provision is made for elevators of 3,000-lb. capacity, 7 ft. 6 in. by 8 ft. $4^3/_4$ in. in size, for each 20-ft. unit. Some of the merchants, however, occupy more than one unit and in this case the elevator for one of the units is omitted, but the units are so arranged that every 20-ft. unit can be served by its own elevator. The stairs serve two units jointly and have entrances both from the units and from the front platform.

Unit No. 1 is 492 ft. 10 in. long by 116 ft. 0 in. wide, and contains 168,503 sq. ft. of floor area. The truck space is protected in front by rolling steel shutters, and similar shutters are provided between the truck space and the store. Doors at the platform end are of the bifold type, 12 by 9 ft. Under the 16-ft. platforms of all units, space is provided for utilities, including the refrigerating pipes of the Federal Cold Storage Company.

Unit No. 2 is 425 ft. 2 in. in length by 100 ft. 0 in. in width and contains 147,635 sq. ft. of floor area. The design is similar to that of Unit No. 1. Unit No. 3 is 261 ft. 6 in. in length by 90 ft. wide and contains 26,150 sq. ft. of floor area. This unit can be extended in the future as additional space is required. Unit No. 4 is 456 ft. 6 in. in length by 90 ft. wide and has a basement under about two-thirds of its area. It has 27,587 sq. ft. of floor space.

The Auction Building is 110 ft. wide by 462 ft. in length and contains 65,838 ft. of floor space. There is a small basement for boiler room and cold storage only. The two-story section, or head house, is 82 ft. by 110 ft. and the remainder is a single story. Concrete was used for the basement, and steel columns and beams, fireproofed with concrete throughout, for the two-story section. The rest of the structure, the single-story part, has brick walls, steel trusses, and a timber roof. The auction room, 48 ft. $9^1/_2$ in. by 64 ft., contains 286 seats and is acoustically treated.

In addition to these buildings there is a smaller structure known as the Dairy Products Building, 40 ft. in width by 130 ft. in length, which has two stories and no basement, and contains 10,544 sq. ft. of floor space. This building is of the mill type.

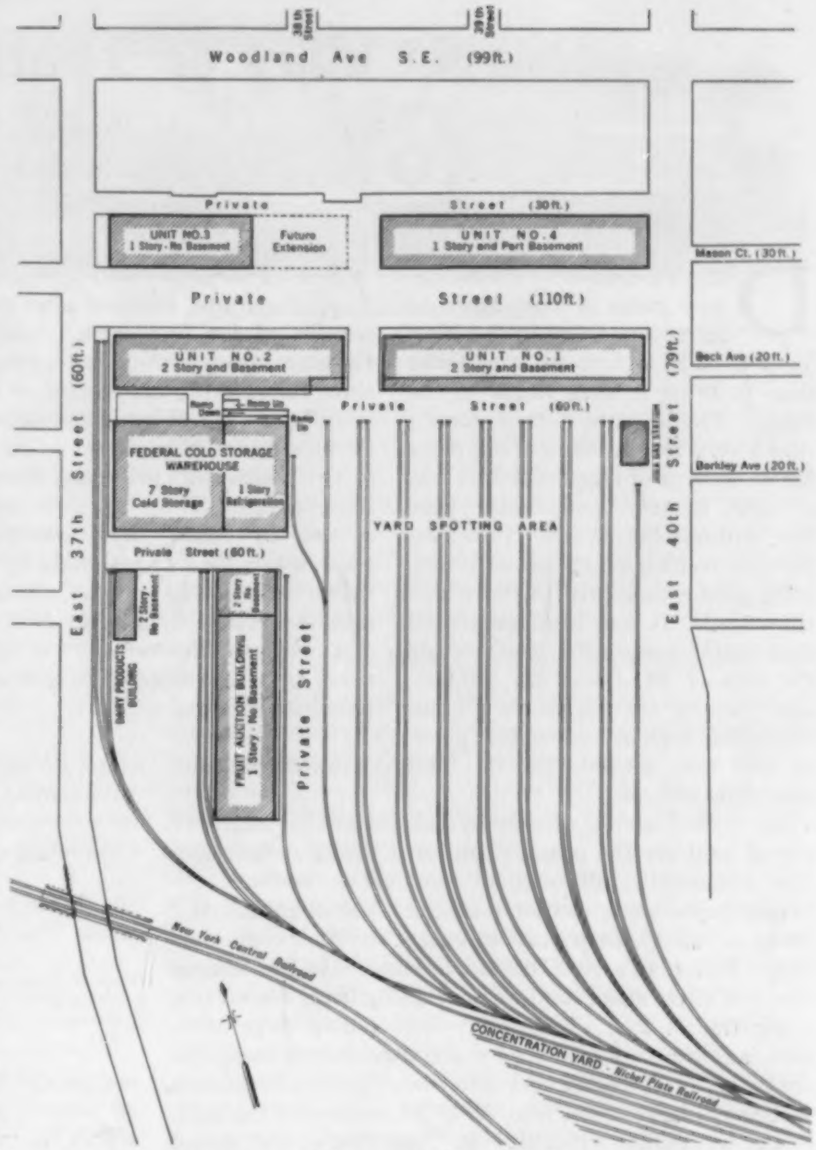


FIG. 2. GROUPING OF BUILDINGS, NORTHERN OHIO FOOD TERMINAL
Easy Access Is Provided to Tracks and Truck Routes

CENTRAL REFRIGERATION PLANT

The cold storage unit was constructed independently by the Federal Cold Storage Company on property leased to it by the development company. This unit comprises a cold storage building 200 ft. square and seven stories high, and a single-story refrigerating building approximately 200 by 100 ft. The latter is of reinforced concrete throughout and is of unique design in that all the outside walls are double, consisting of a 12-in. outer wall and a 16-in. inner bearing wall, between which was placed 16 in. of ground cork. The interior ceiling insulation and the roof insulation are of the wool type.

Excess capacity was provided in the refrigeration plant so that it could furnish refrigeration to the various stores in Units 1 and 2 of the terminal development. This refrigeration is supplied through pipe lines installed when the units were constructed.

PERSONNEL

The entire development was carried out under the direct charge of W. J. Bergen, Engineering Assistant to the President of the Nickel Plate Railroad. Wilbur J. Watson and Associates were the architects and engineers for all the buildings, with the exception of the cold storage unit. Unit No. 1 was built by the Craig-Curtiss Company; Units 2, 3, and 4, by the Sam W. Emerson Company; the Auction Building, by the Hunkin-Conkey Construction Company; and the Dairy Products Building, by the George A. Rutherford Company, all of Cleveland. The engineers for the Federal Cold Storage Company were the Ball Ice Machine Company of St. Louis, and the general contractors were the Blome Sinek Company of Chicago.

Street Cars or Traffic Jams?

Restrictions Hamper an Efficient Means of Mass Transportation

By William D. Johnson

Chevy Chase, Md.

In any large city the proper solution of the traffic problem taxes the ingenuity of the best experts available. For mass transportation the once popular street car is being supplanted in many localities by the private automobile and the public bus. Considered on the basis of space occupied, street cars have been shown to be on the average three times as efficient as buses. Mr. Johnson has given much time to his study of street railways. Although never connected with the railway industry, he believes that the possibilities for a greater use of street cars deserves the serious consideration of municipalities.

Delays caused by traffic tie-ups make it cost more to move a package from a New York dock to an uptown warehouse than to bring it from China to the dock. Traffic jams today constitute a very real problem of our daily life as sources of inconvenience, loss of time, anxiety, and death—this, too, without taking into consideration the tremendous financial losses, both public and private, to which they lead. It has been estimated that traffic congestion yearly costs the city of St. Louis $37,500,000; and its cost for the whole United States has been conservatively given as well over $2,000,000,000. This condition can and should be remedied.

An inefficient use of streets and an unduly intensive use of land are the primary causes of traffic congestion. The automobile, although of manifest social and economic importance, cannot take the place of established forms of mass transportation, except in small communities. Failure to accept this fact lies back of our enormous waste of street space, and we are rapidly being forced to a realization of this. Even now, despite their large numbers, automobiles account for a comparatively insignificant part of the passenger movement in the downtown sections of large cities, from 50 to 80 per cent of the total being by public vehicles. In New York, by actual count, storekeepers learned that less than 4 per cent of their patrons came by private auto. In Table I, the percentages given for total vehicles entering congested districts and passengers carried by them are the average for ten large cities from 1924 to 1928. The statistics were taken from a report of the National Conference on Street and Highway Safety.

PARKING AGGRAVATES TRAFFIC CONGESTION

Parked automobiles are the worst offenders in adding to the congestion of our streets. The abolition of parking may be undertaken in several ways. It may be prohibited at certain parts of the street, such as intersections; it may be limited to designated hours; or it may be forbidden entirely, at least in necessary areas. In the Chicago Loop, for example, a parking ban was established January 10, 1928. Since then, this district has seen a reduction in accidents of 10 per cent, an increase in automobile speed of from 20 to 30 per cent, and an increase in street car speed of from 15 to 30 per cent. At the same time, all forms of business have been stimulated by the larger volume and freer flow of traffic.

At the beginning of the twentieth century, street cars began to spread all over the country. They were such an improvement over other forms of transportation at that time, that like a number of other industries they were overdeveloped, and tracks were laid everywhere on all sorts of pretexts. Many routes were improperly constructed and never did pay, so that when the bus, much cheaper in operation, was introduced, they were naturally abandoned in its favor. This striking of a balance between trolley car and bus has led many to erroneous conclusions.

Few people realize how inseparably connected are urban growth and transportation, and even smaller is the number of those who appreciate, or care to appreciate, the part electric railways have played in the development of American cities. Yet, on reflection, this part certainly seems obvious enough. Computations made in New York have revealed that 91

Table I. Comparative Use of Passenger Vehicles Entering Central Districts of Cities

Type of Vehicle	Per Cent of Total Vehicles	Per Cent of Passengers	Street Space Occupied Sq. Ft. per Rider
Automobile	90.3	32.3	53.0
Street Car	8.5	61.6	4.5
Bus	1.2	6.1	6.7

per cent of its borough population is concentrated in the 40 per cent of its area that lies within a half mile on each side of the rapid transit lines. Now a city must grow, and clearly it can grow in but two directions, vertically and horizontally. If transit facilities are swift and widespread the city will extend outwards; if not, there will be a distinct tendency toward the building of skyscrapers.

When the gasoline bus was first introduced, perhaps

Trolley Bus Used in New Orleans

Over 200 Such Vehicles Are Now in Operation in the United States; Kenosha, Wis., Recently Adopted Them Exclusively

Stream-Lined Interurban Electric Car
Operates Between Philadelphia and Norristown, Pa.;
Maximum Speed 100 Miles per Hour

10 or 11 years ago, its novelty, flexibility, and comparatively small first and operating costs caused it to become so extensively used that a great many people thought the trolley car was doomed. Since then, however, experience has clearly demonstrated that, although the bus is here to stay, it will not, indeed cannot, displace the electric car. For heavy urban passenger movement, the latter has been found not only swifter and more capable, but also cheaper to operate, and the bus seems to have found its permanent field in de luxe express service, supplementary feeder lines, and light passenger traffic.

Even London, traditional stronghold of the bus, is quite dependent on its electric railway lines. London buses carry only 33 per cent of the total passengers transported in public vehicles. The remainder is transported by electric traction systems: 35 per cent by tram, 21 per cent by subway, and 11 per cent by suburban railway.

The trolley bus, a recent electric railway innovation which appears to be spreading very rapidly, is well suited for traffic of medium density too light for the trolley, yet too heavy for the bus.

What the street railway primarily needs today is to have the public understand its problems. Here is a \$5,800,000,000 industry, operating 101,000 cars and buses over 72,000 miles of route, carrying 40,000,000 passengers daily, and having an annual payroll of \$445,000,000, which, like its big brother, the steam roads, is literally taxed and regulated to death. The yearly taxes paid by street railways amount to 10 per cent of their gross receipts, or nearly \$100,000,000. Despite this, their attempts to improve service by seeking the cooperation of traffic officials are viewed with suspicion, while suggestions that they be relieved of such unjust

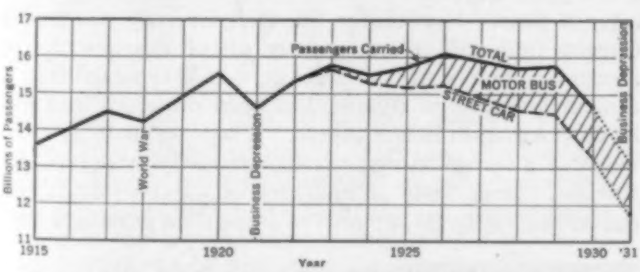


Fig. 1. Passengers Carried by Street Cars and Buses
Showing Dependence of the United States Upon Street Railways

burdens as the upkeep of public parks or the salaries of policemen, are greeted with downright indignation. Yet, when such expenses benefit the municipality as a whole, it is surely wrong to compel their payment by a utility that is patronized only by the poorer classes.

In many cases, of course, the railway itself is to blame for this lack of sympathy because the service rendered and the equipment used do not justify public confidence, but the majority of tramways today are sincere in their suggestions for community improvement. They cannot move their cars as rapidly as they would like, partly because of the growing swarm of automobiles, and partly because of the problem of pedestrians crossing streets, which is accentuated by high office buildings. When officials of street railways propose that traffic be segregated according to vehicular types, or that an earnest attempt be made to resolve parking evils, they are not given the cooperation that these questions merit, either by municipal authorities or by the public itself, although such changes, however drastic they may seem at first, cannot but result in benefit to the city.

Large Expenditures for Modern Equipment

Experimental research costs the street car industry thousands of dollars each year in its quest for swifter, more comfortable cars and better trackage. An almost noiseless car has been developed by the Chicago and Joliet Electric Railway; the Lehigh Valley Transit Company has adapted the principle of "free wheeling" to railway usage, with encouraging results; and the city of Baltimore has cars so fast in accelerating from a standing start that automobiles cannot "cut in" in front. The Cincinnati and Lake Erie, an interurban line that not long ago was in rather severe financial straits, purchased in 1930 a number of new stream-lined cars which have reached speeds of as high as 91 miles per hour. A car built by airplane designers after hundreds of wind tunnel tests to secure minimum wind resistance, is illustrated. It is operated between Philadelphia and Norristown, Pa., by the Philadelphia and Western Railroad Company, and is capable of 100 miles per hour.

The crux of the whole situation is the lack of a real plan or policy on the part of the city. Changes from street cars to buses are inaugurated or accepted without consideration of their possible after-effects or of the future needs of the community. The need then is for a comprehensive traffic plan formulated through the coordinated work of chambers of commerce, automobile clubs, street railways, and other local organizations interested in this subject. In areas where the traffic movement is highly complicated there might well be established a special traffic commission, preferably a part of the city planning body. Local interest should be aroused so that the movement would be sponsored by the entire community.

This commission could then make a special study, if necessary, of the city's transportation problem, and recommend the proper steps for its solution. At any rate, since a public utility is not purely a commercial venture, street car lines must be regarded as public property, whether or not they represent private capital, and as such they should be given some relief from taxes and granted modern franchises.

Protection of Concrete by Glazed Tile

Life of Irrigation Structures Prolonged by Use of Special Facing

By AUGUSTUS GRIFFIN
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CHIEF ENGINEER, DEPARTMENT OF NATURAL RESOURCES, CANADIAN PACIFIC RAILWAY, BROOKS, ALBERTA

IN Alberta, Canada, much difficulty has been experienced by the Canadian Pacific Railway in building irrigation structures of concrete to withstand the action of water and extreme temperature variations. In his experience there during the past 12 years, Mr. Griffin has used surface facings of glazed clay well bonded to the concrete to prevent the water both from entering, and from passing through, the concrete. From observation he has been convinced that this method has real value and that it should be called to the attention of the profession. He suggests the use of hollow glazed tile in concrete dams and of glazed pipe as forms for piles.

IN its nature, concrete is a conglomerate rock, basically pervious. Aside from the aggregate, it is made up of cementing materials which are soluble and inherently capable of taking part in chemical reactions. Therefore it can be destroyed by water as a solvent, by the forces of freezing and other temperature changes acting on the absorbed water, by the forces of crystallization of substances in solution, and by chemical reaction with substances in solution. The fact that water is a constituent of the cementing material and is probably never present in the exact amount and distribution and under exactly the right conditions to give a perfect reaction, in itself implies a degree of perviousness.

Fortunately, most concrete is in service under conditions that are sufficiently favorable, from the standpoint of human requirements, so that it may be considered permanent. Unfortunately, on the other hand, much concrete has been disintegrated by the action of water, either within or on the surface, in conjunction with temperature variation—particularly freezing and thawing—and the presence of soluble substances.

My experience in the last 13 years has been in Alberta, Canada, where temperature extremes of −50 deg. and +100 deg. fahr. are experienced, where the temperature varies greatly throughout the freezing and thawing range, and where there is much soluble matter (mainly sulfates) in the soil and water. Disintegration of concrete has been so serious a matter that this material has been used only where conditions were favorable, or where no other material could be readily substituted. When concrete was used, its durability was safeguarded, as far as possible, by improving the quality of materials and methods of construction, by drainage, by waterproofing with bituminous and other compounds, and by such other expedients as were indicated under the circumstances. These expedients are all of value, within limits, and have their proper places in practice.

Much has been learned in recent years about portland-cement concrete, the destructive agents to which it may be subjected, and the precautions which can be taken to increase its durability. Nevertheless, it is not possible, in my opinion, to manufacture a portland cement concrete that will be reasonably durable if exposed to certain conditions which may be encountered in many localities. Yet it may be highly desirable, or even necessary, to use concrete under such conditions.

Of hundreds of specimens manufactured locally and in various laboratories in Canada and the United States, using various cements, aggregates, mixes, and protective coatings and compounds, and exposed by half burying them in wet alkaline soil, many have disintegrated within a frost-free period and none have remained uninjured after a year. Eventually the chemist may produce a cement that will resist some or all of the destructive agents commonly met in practice. It is reported that a cement resistant to sulfates has been produced and will be on the market in due course. There seems to be some merit in a manufactured product recently introduced in Europe. It consists of mixtures of concrete aggregate containing up to 20 per cent of stone dust passing a 100-

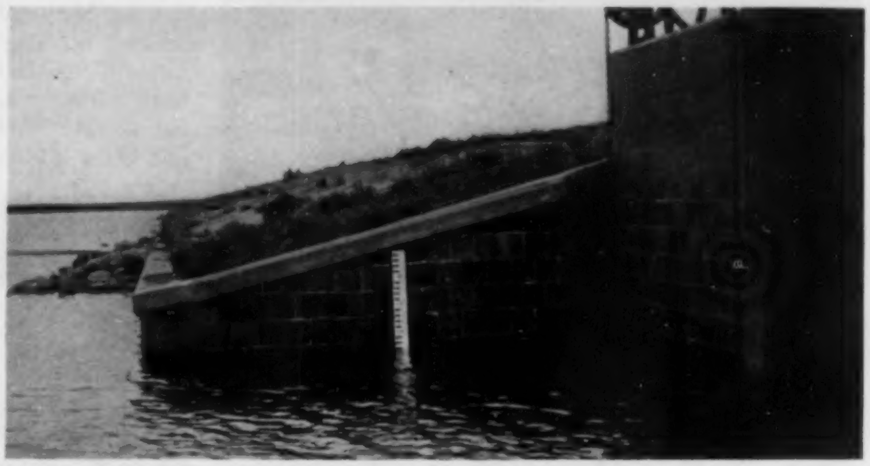
In Need of Repair, Fall of 1921
Reinforcing in Retaining Wall Exposed

Repaired and Glazed Tile Facing Added, Fall of 1926
Discoloration of Wall Due to Dried Algae

18-FT. DROP ON THE NORTH BRANCH CANAL, CANADIAN PACIFIC RAILWAY IRRIGATION SYSTEM

Before Repaired, 1926

Downstream Side. After Repairs Were Completed, 1927



Upstream Side Repaired with Glazed Tile Facing
BANTRY HEADGATES, CANADIAN PACIFIC IRRIGATION SYSTEM

mesh sieve, held together with a specially prepared organic pitch binder. It is mixed and placed at rather high temperatures. Specimens have been found to be uninjured after two years of exposure in an alkali test plot.

About 12 years ago I began, in a small way, to use glazed tile facing when making repairs on exposed concrete faces. This tiling was used where it was likely that the exposed face would be saturated with moisture when winter set in, or where water moving through the concrete from the back-filled side would carry in solution salts that would become concentrated by evaporation on the exposed face. The practice has been continued where conditions were favorable and has been extended to some new construction. Observation from year to year indicates that the method has real merit and that there is justification in calling it to the attention of the profession.

TILE FOR FACING MADE TO ORDER

One obstacle to the more extensive use of glazed tile facing has been the lack of suitable shapes. The 4 by 12 by 12-in. glazed hollow building tiles that have been used in Alberta were made to order in car lots as required. The web parts were half cut through by knives specially placed in the die and after delivery at the job the tiles were broken, by several sharp blows of a light hammer, into two slabs, each 12 by 12 in., with four ribs on one side. In order to improve the bond with the concrete the ribs and the ribbed face are roughened by suitable tools placed in the die.

As the concrete is placed, these slabs are laid up, smooth side against the form supports, and are well bonded by the ribs and roughened surfaces. Form supports may be 3 in. wide on 12-in. centers, as the slabs constitute the sheeting. There is some saving here, which compensates, at least in part, for the increased cost of the tile. The completed face should be 98 or 99 per cent glazed surface. It is likely that the joint area could be decreased below 1 or 2 per cent by the use of larger slabs more accurately dimensioned. Durability may be improved by suitable pointing of the joints. For practical purposes, the glazed face, and possibly the tile

Concrete Severely Deteriorated, 1923

Partial Repair with Glazed Tile Facing, 1927

SPRING HILL CANAL, DROP NO. 1, CANADIAN PACIFIC RAILWAY IRRIGATION SYSTEM

itself, can be considered impervious and it greatly reduces the amount of water entering or leaving the concrete through the tiled face. It is important that there should be no pockets between the tile and the concrete, as these might accumulate water, which would freeze or otherwise contribute to deterioration.

The gratifying experience with glazed tile facing on relatively small structures suggests the extension of its use to larger structures such as dams. It is further suggested that it be used to form continuous hollow curtains or diaphragms, both horizontally, in the foundations, and vertically, at or near the front faces. For such uses, it seems evident that the hollow tile blocks would need to resist forces of considerable magnitude. Tests show that the 4 by 12 by 12-in. glazed hollow blocks used in my work will support a load of about 80,000 lb. on a 12 by 12-in. face. This is about 555 lb. per sq. in. of surface area and about 4,000 lb. per sq. in. of rib cross section. No doubt the clay products industries can produce blocks of very much greater strength if there is a demand for them. Great improvements can be made in the design of tiles for these special purposes in the matter of shapes, sizes, accuracy of dimensions, and special facilities for using them. Hand in hand, a technic in design and use can be developed. In many uses the tile would not be exposed to view; however, even a plain tile face is not unpleasing in appearance, and very effective results could be obtained by combinations of colors and shapes.

USE OF TILE FOR THIN WALLS C.P.R. SYSTEM

It seems probable that columns and piles, at least piles which are to be jetted, can be made by using glazed pipes as forms. In this case there would be problems in connection with a surplus or deficiency of water due to the impervious casing. There are also the problems of shrinkage or expansion of the concrete within a rigid shell. Facing both sides of a thin wall introduces some of these difficulties, especially where freezing temperatures obtain. For these reasons, I have used double facing only once, on walls where circumstances made it possible to cure them progressively in 1 and 2-ft. lifts.

In order to get some comparative data, a number of materials were saturated with water, weighed, and exposed in the office. They were then weighed at intervals to determine the rate at which they lost water. A fragment of glazed tile absorbed water to the amount of 4 per cent of its weight, but probably this is not indicative of the behavior of the glazed face. This specimen lost weight slowly and at a diminishing rate, reaching its original weight in about 30 days. Small fragments of a very dense cement plaster and of gunite each absorbed 2.6 per cent of their weight of water, and on exposure continued to lose weight for from two to four months. Fragments of tile, one hard-burned but not glazed or vitrified, and one commercially soft-burned, absorbed 9 and 13.8 per cent of their weight of water, respectively. On exposure they lost weight very rapidly and returned to their original weight in 9 days. In structures and in the exposure plot the glazed tile has remained uninjured while all the other products have disintegrated or have shown signs of deterioration in one place or the other.

This article is presented in the hope that it will be helpful, not only in calling attention to the methods described, but also in stimulating discussion of them. Previous discussion of the matter with a number of engineers, both verbally and by correspondence, has called forth considerable interested and favorable comment. As far as I know, tile has not been used to any great extent, if at all, for the purposes described, although it has been used in sewers for protecting concrete from sewer gases, for reducing wear, and possibly for other reasons. Quite probably a discussion will bring out the experiences of engineers who have already used it for the purposes described or in other interesting ways.

BASSANO DAM SPILLWAY, C.P.R. SYSTEM
Disintegration of Pier

HINTS THAT HELP

Today's Expedient—Tomorrow's Rule

The minutiae of everyday experience comprise a store of knowledge upon which we depend for growth as individuals and as a profession. This department, designed to contain practical or ingenious suggestions from young and old alike, should afford general pleasure not unmixed with profit.

When Elevation Does Not Produce River Flow

By C. E. Grunsky

Past-President, American Society of Civil Engineers
Consulting Engineer, C. E. Grunsky Company, San Francisco

IN CONNECTION with studies relating to the type of barrier that would best serve to hold back ocean water and prevent the penetration of brackish water into the lower channels of the Sacramento and San Joaquin rivers, California, I have given some attention to the advantage that would result from the use of shallow instead of deep flood gates. If this proposed structure is ever constructed, it will be desirable during flood stages to keep the water upstream from it at as low an elevation as possible. Consequently, the super-elevation at the flood gates necessary to force the upstream fresh water out under the gates against the greater pressure of the ocean water received consideration.

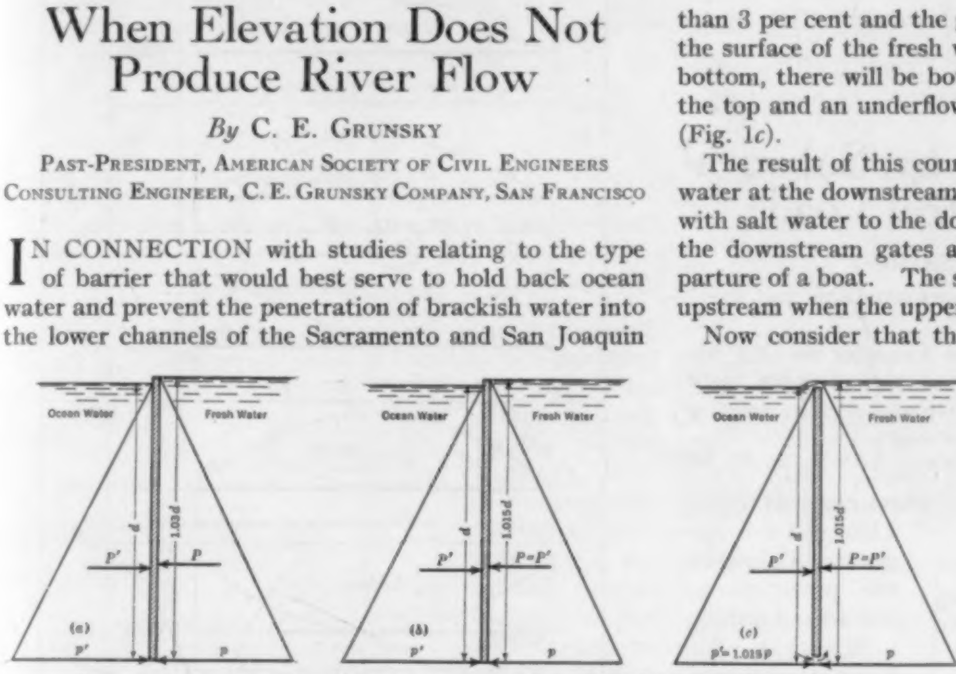


Fig. 1. Pressures on a Vertical Barrier Between Salt and Fresh Waters
(*a*) When $p = p'$, then $P = 1.03\ P'$. (*b*) When $P = P'$, then $p' = 1.015\ p$.
(*c*) Counter Flow with Gate Raised from Bottom and Lowered at Top

When fresh water is separated from ocean water by a gate it is of course obvious that:

1. The water pressure on the two sides of the gate at the bottom will be equal when the fresh water has a super-elevation equal to about 3 per cent of the depth of the ocean water. Thus, for example, when the gate sill is 60 ft. below the surface of the ocean water the fresh water must have a super-elevation of about 1.8 ft. to make the unit pressure at the bottom of the gate the same on both sides (Fig. 1*a*).

2. Whenever the super-elevation is less than 3 per cent and the gate is slightly raised, the ocean water will flow under. Whenever the super-elevation is greater, the fresh water will flow under, into the ocean water.

3. The aggregate water pressures on the two sides of the gate will be equal when the fresh water has a super-elevation of about 1.15 per cent of the depth of the ocean water (Fig. 1*b*).

4. When the super-elevation of the fresh water is less than 3 per cent and the gate is lowered at the top below the surface of the fresh water, and slightly raised at the bottom, there will be both an overflow of fresh water at the top and an underflow of ocean water at the bottom (Fig. 1*c*).

The result of this counter flow between salt and fresh water at the downstream gates of a lock is to fill the lock with salt water to the downstream water level whenever the downstream gates are opened for the entry or departure of a boat. The salt water within the lock will go upstream when the upper lock gates are opened.

Now consider that there is substituted for the gate, with its thickness of a few feet, a long stretch of brackish water, such as is found in all estuaries of rivers discharging into the ocean. This brackish water will be graded as to salt content from that of ocean water at its lower extremity, to a negligible amount at its upstream limits. The stretch of channel filled by it may have a length of 20 or even 100 miles or more.

As a specific example, the lower reaches of the Sacramento and San Joaquin rivers in California, and the waters of Suisun and San Pablo bays—the upper waters of San Francisco Bay—may be considered in this connection. Here the distance involved may be 50 miles or more according to the river stage at the moment. The depth of the brackish water in this stretch is generally from 50 to 60 ft., with 90 ft. in the contracted outlet of San Pablo Bay. For ordinary conditions it is probable that throughout this stretch of brackish water, whatever its length may be, the fresh water must attain a super-elevation sufficient to force flow against about 60 ft. of ocean water. Treating the stretch of brackish water as though it were a gate with a thickness of some 50 miles, it will at once be clear that this super-elevation must be at least 1.5 per cent of 60 ft., or about 0.9 ft.

Now if tides and river flow could be stopped for a time, the entire stretch of brackish water would be in equilibrium, due to the thorough mixing of salt and fresh water from surface to bottom and the very gradual change from fresh water to ocean water in the reach. This would be the case despite the fact that at its upper end the water surface would be nearly one foot higher than at its lower end. It follows that rivers discharging into the ocean have short or long stretches of brackish water in which only a part of the gradient causes flow, the other part being required to overcome the resistance of the heavier ocean water.

Where barriers are to be erected to prevent the pene-

tration of ocean water into fresh water lakes, and where it is desirable at the same time to prevent high flood stages in the lakes, it follows that the outflow channels should be broad and shallow, not narrow and deep. The super-elevation of fresh water at a gate with a sill 60 ft. deep should be nearly 2 ft. to make sure that there will be no counter flow, but at a gate with a sill 15 ft. deep it may be less than 1/2 ft. In a long runway for outgoing water, these super-elevations might be reduced about 50 per cent—still showing a material advantage for the broad, shallow type of outlet.

Beam Deflection by Substitution of a Central Load

By the late M. J. SHAMRAY
MEMBER AMERICAN SOCIETY OF CIVIL ENGINEERS

STANDARD handbooks give formulas for the deflection of beams for a few special cases only. In the many other cases frequently met with in practice, usually the differential equation, $\frac{d^2y}{dx^2} = \frac{M}{EI}$, or the principle of least work, is used. These methods require a long series of computations, making the procedure involved and tedious.

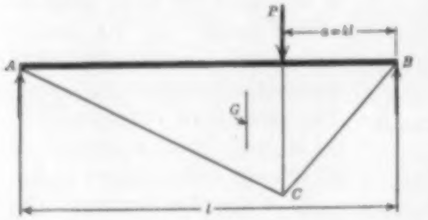


FIG. 1.

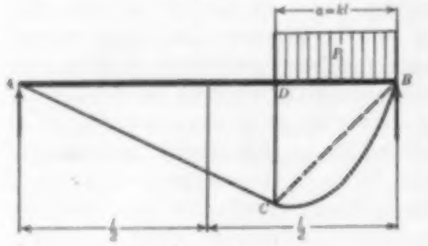


FIG. 2.

Whether the beam is continuous or restrained at the supports, and whether the loading is concentrated or distributed, the problem may be reduced to the case of a simple beam with a single load concentrated at the middle.

This single load is called the Equivalent Central Load (P_c). Having determined P_c, the maximum deflection is then given by the simple, well known formula: $D = \frac{P_c l^3}{48 EI}$.

To obtain the necessary formulas and constants for these deflections, use is made of the well known method of area moments. For convenience it is assumed that the deflection at the center of the span is the maximum. Actually this is seldom true for unsymmetrical loading, but for all practical purposes it is near enough, especially because the deflections vary little near this middle point.

S.MPLE BEAM

Take a simple beam, AB (Fig. 1), sustaining a load, P, at a distance, a, from B. Let this distance be called kl, in terms of the span length l. Then the moment of the moment area to the left of the center, about the center, will be: $M' = \frac{P l^3}{48} k(3 - 4k^2)$, giving the deflection at the center. In other words, for all practical purposes any eccentric load, P, will cause the same

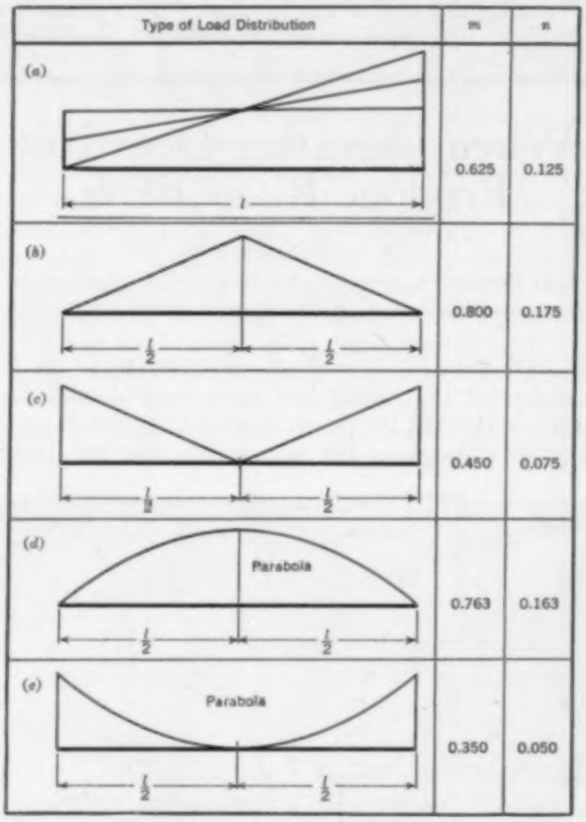


FIG. 3. CONVERSION FACTORS FOR DISTRIBUTED LOADS

deflection as a central load P_c if

$$P_c = P k (3 - 4k^2) \quad \text{[1]}$$

If there are several loads acting at various points, they can be replaced by a single central load:

$$P_c = \Sigma P m \quad \text{[2]}$$

in which

$$m = \text{conversion factor} = k(3 - 4k^2) \quad \text{[3]}$$

FULL RESTRAINT AT SUPPORTS

Assume a negative movement of $-M_1$ at one end of the beam in Fig. 1, due for example to a cantilever load beyond that end. Following the same method of deduction as before, it may be found that the deflection caused at the center is equal to that caused by a negative load, P_c, such that $P_c = \frac{3M_1}{l}$. For an additional moment, $-M_2$, at the other end, the relation would be: $P_c = \frac{3(M_1 + M_2)}{l}$. Combining concentrated loads and negative moments at the supports, Equations 2 and 4, the equivalent central load would need to be:

$$P_c = \Sigma P m + \frac{3(M_1 + M_2)}{l} \quad \text{[4]}$$

Note that the moments must be applied with the correct algebraic sign.

For a simple load on a restrained beam, it is found that $P_c = P\,k^2(3 - 4\,k)$; from which is obtained the conversion factor:

$$n = k^2(3 - 4\,k) \ldots\ldots\ldots\ldots [5]$$

UNIFORMLY DISTRIBUTED LOADS

In Fig. 2 the total uniform load P is distributed over a length, $a = kl$, giving a moment curve as shown. As before, computing the deflection at the center, it is found to be the same as that from a central load, P_c, in which

$$P_c = P\,k\,(1.5 - k^2) \ldots\ldots\ldots\ldots [6]$$

and we obtain a conversion factor,

$$m = k\,(1.5 - k^2) \ldots\ldots\ldots\ldots [7]$$

If the end B is restrained, the conversion factor is found to be:

$$n = k^2\,(1 - k) \ldots\ldots\ldots\ldots [8]$$

Where the uniform load does not extend to the support, as in Fig. 2, the correct result is found by first assuming the same intensity of load continuing to the support, and subtracting from the resulting deflection that due to the proportionate load just added. In case the load extends beyond the center of the span, the deflections are computed separately for the parts of the load on each side, and the results are added.

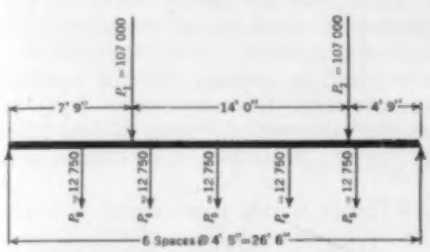


FIG. 4. LOADING DIAGRAM FOR THE PLATE GIRDER IN EXAMPLE 1

OTHER LOADS

These methods are useful in obtaining deflections for other types of loading. For example, if a load distributed over the whole span uniformly varies in intensity from zero, or from a given amount at one end to a different amount at the other, the conversion factors remain the same as for an equal total load, uniformly distributed.

In general, when the load distribution follows a rule too complicated to be treated analytically, or is too irregular, the total load can be considered as consisting of several loads properly spaced. Both concentrated and distributed loads can thus be substituted.

COEFFICIENTS

The values of the conversion factors, m, from Equations 3 and 7, for simple beams are given in Table I. Those for fully restrained beams, factors n, obtained from Equations 5 and 8, are similarly found in Table II.

Tables I and II give conversion factors for finding the equivalent central load in terms of the distances of the central loads from their nearest support, using values of k as arguments. In the main vertical divisions, k varies by tenths, and in the horizontal subdivisions, by hundredths. In each table, roman numerals refer to concentrated loads, and italic numerals to uniformly distributed loads. In Fig. 3 are given conversion factors for several simple load distributions.

TABLE I. CONVERSION FACTORS, m, FOR SIMPLE BEAMS

Upper Values for Concentrated Loads, Lower Values in Italics for Loads Uniformly Distributed

Values of k	Intermediate Subdivisions of k: 0	0.01	0.02	0.03	0.04	0.05	0.06	0.07	0.08	0.09
0.00	0.000	0.030	0.060	0.090	0.120	0.150	0.179	0.209	0.238	0.267
	0.000	*0.015*	*0.030*	*0.045*	*0.060*	*0.075*	*0.090*	*0.105*	*0.120*	*0.134*
0.10	0.296	0.325	0.353	0.381	0.409	0.437	0.464	0.490	0.517	0.543
	0.149	*0.164*	*0.178*	*0.193*	*0.207*	*0.222*	*0.236*	*0.250*	*0.264*	*0.278*
0.20	0.568	0.593	0.617	0.641	0.665	0.688	0.711	0.731	0.752	0.772
	0.292	*0.306*	*0.319*	*0.333*	*0.346*	*0.359*	*0.372*	*0.385*	*0.398*	*0.411*
0.30	0.792	0.811	0.829	0.846	0.863	0.879	0.893	0.907	0.921	0.933
	0.423	*0.435*	*0.447*	*0.459*	*0.471*	*0.483*	*0.493*	*0.504*	*0.515*	*0.526*
0.40	0.944	0.954	0.964	0.972	0.979	0.986	0.991	0.995	0.998	0.999
	0.536	*0.546*	*0.556*	*0.565*	*0.575*	*0.584*	*0.593*	*0.601*	*0.609*	*0.617*
0.50	1.000	....	....	....	....	....	....	....	....	....
	0.625	....	....	....	....	....	....	....	....	....

TABLE II. CONVERSION FACTORS, n, FOR FULLY RESTRAINED BEAMS

Upper Values for Concentrated Loads, Lower Values in Italics for Uniformly Distributed Loads

Values of k	Intermediate Subdivisions of k: 0	0.01	0.02	0.03	0.04	0.05	0.06	0.07	0.08	0.09
0.00	0.000	0.000	0.001	0.003	0.005	0.007	0.010	0.013	0.017	0.021
	0.000	*0.000*	*0.000*	*0.001*	*0.002*	*0.002*	*0.003*	*0.005*	*0.006*	*0.007*
0.10	0.026	0.031	0.036	0.042	0.048	0.054	0.060	0.067	0.074	0.081
	0.009	*0.011*	*0.013*	*0.015*	*0.017*	*0.019*	*0.022*	*0.024*	*0.027*	*0.029*
0.20	0.088	0.095	0.103	0.110	0.118	0.125	0.133	0.140	0.147	0.155
	0.032	*0.035*	*0.038*	*0.041*	*0.044*	*0.047*	*0.050*	*0.053*	*0.056*	*0.060*
0.30	0.162	0.169	0.176	0.183	0.190	0.196	0.202	0.208	0.214	0.219
	0.063	*0.066*	*0.070*	*0.073*	*0.076*	*0.080*	*0.083*	*0.086*	*0.090*	*0.093*
0.40	0.224	0.229	0.233	0.237	0.240	0.243	0.245	0.247	0.249	0.250
	0.096	*0.099*	*0.102*	*0.105*	*0.108*	*0.111*	*0.114*	*0.117*	*0.120*	*0.123*
0.50	0.250	....	....	....	....	....	....	....	....	....
	0.125	....	....	....	....	....	....	....	....	....

EXAMPLE 1

Consider the case of a steel plate girder, 26 ft. 6 in. long between free supports. The section is made up of web plates 36 in. by $^9/_{16}$ in.; flange angles 4 ft. 6 in. by 6 in. by $^5/_8$ in.; and two cover plates, 14 in. by $^5/_8$ in. The moment of inertia, with rivet holes deducted, is $I = 14.885$ (in.)^4. Loads from floor beams and columns are as shown on Fig. 4. The computation of the equivalent central load follows:

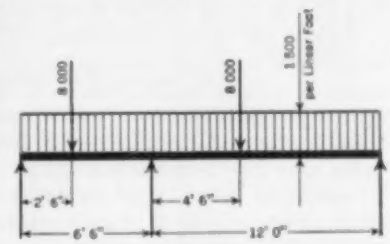


FIG. 5. LOADING DIAGRAM FOR THE CONTINUOUS BEAM IN EXAMPLE 2

$$P_1 = 107{,}000;\ k_1 = \frac{7.75}{26.5} = 0.29;\ m_1 = 0.772;\ P_1m_1 = 82{,}604$$

$$P_2 = 107{,}000;\ k_2 = \frac{4.75}{26.5} = 0.18;\ m_2 = 0.517;\ P_2m_2 = 55{,}319$$

$$2P_3 = 25{,}500;\ k_3 = \frac{4.42}{26.5} = 0.17;\ m_3 = 0.490;\ 2P_3m_3 = 12{,}495$$

$$2P_4 = 25{,}500;\ k_4 = \frac{8.83}{26.5} = 0.33;\ m_4 = 0.846;\ 2P_4m_4 = 21{,}573$$

$$P_5 = 12{,}750;\ k_5 = \frac{13.25}{26.50} = 0.50;\ m_5 = 1.000;\ P_5m_5 = 12{,}750$$

$$P_c = 184{,}741$$

Resultant deflection,

$$D = \frac{P_c l^3}{48\ EI} = \frac{184{,}741 \times 26.5^3 \times 12^3}{48 \times 29{,}000{,}000 \times 14{,}885} = 0.286 \text{ in.}$$

EXAMPLE 2

Consider also the case of a turbo-generator support made up of two 24-in. 80-lb. I-beams, 18 ft. 6 in. long, continuous over three supports, each beam loaded as shown in Fig. 5. The negative moment over the central support equals 35,200 ft-lb.; the end supports are free; and the moment of inertia, I, equals 2,087.2 (in.)^4. The computation of the equivalent central load for the longer span of 12 ft. 0 in. resembles the previous case with the added provision for uniform load and negative moment:

Concentrated load =

$$8{,}000 \text{ lb.};\quad k = \frac{4.5}{12.0} = 0.38;\quad m = 0.921;\ Pm = 7{,}368$$

Uniformly distributed load =

$$18{,}000 \text{ lb.};\quad m = 0.625;\ Pm = 11{,}250$$

$$Pm = 18{,}618$$

$$\text{Reduction for negative moment} = \frac{3\,M}{l} = \frac{3 \times -35{,}200}{12} = -8{,}800$$

$$P_e = 9{,}818$$

$$\text{Resultant deflection, } D = \frac{9{,}818 \times 12^3 \times 12^3}{48 \times 29{,}000{,}000 \times 2{,}087.2} = 0.011 \text{ in}$$

Our Readers Say—

In Comment on Papers, Society Affairs, and Related Professional Interests

Engineers Can Help

TO THE EDITOR: The article by Mr. Flinn on "Leadership in Economic Progress" is the sort of challenge we engineers need. It seems evident that the fundamental cause of the present breakdown in our industrial machine is the lack of buying power in the poorer classes. It is often said that a cause of the depression was over-production in 1928 and 1929, but as a matter of fact there were very few lines in which goods were produced in excess of the quantity the people would have bought if they had had the money. The fact that our industrial machine was able to produce these goods shows that the nation as a whole was able to maintain the standard of living that would result from their consumption. As Mr. Flinn infers, "To have a more nearly fair division of the wealth which can be so abundantly produced" is the fundamental need.

Some old-school economists hold that the manner in which the national income is divided is immaterial, because if a large share goes to those who cannot possibly spend it, they will reinvest it and it will then be spent for labor and materials just as it would if it had gone to labor and the "white collar class" in the first place. It is obvious, however, that this will sooner or later lead to such an expansion of plant that investors will decide that it is unwise to invest further. Those who have been employed in the expansion will be thrown out of work, consumer demand will immediately fall off, and the depression toboggan will have started.

If the excess profits taxes and high income taxes which were in force during the war had been continued, it is quite certain that industry would have turned over to labor a much larger proportion of the profits which have resulted from the improved technological processes developed by engineers. Much fun has been poked at the laborers who purchased silk shirts during the war. But it was not only silk shirts that they bought. It was electric washing machines and vacuum cleaners, overstuffed furniture and automobiles—just the sort of goods that our industry was anxious to produce. It is this very fact, that the wage earner as a class spends such a large proportion of his income and saves so little, that makes it to the advantage of the country as a whole to have a larger proportion of the national income go to him.

It has been estimated by Prof. Morris A. Copeland that in 1928 the total realized income of the United States averaged about $3,725 per family of five. If this had been so distributed that no family received less than $2,000, the prosperity that would have resulted staggers the imagination. Actually, since 90 per cent of the gainfully employed had an average income of about $1,500 a year, it is probable that well over half the families in the United States had incomes of less than $2,000 in 1928. Today the situation is, of course, still worse.

Even if we are convinced that a more equal distribution of income is a *sine qua non* of stable national prosperity, the question as to how it may be obtained still confronts us. Measures which might have been effective in preventing the present breakdown of our industrial machine may be insufficient to get it back into operation again. It would seem, however, that if there is any way out, the engineer with his intimate knowledge of industrial processes and his habit of facing and analyzing facts, should help lead the way. The fact that, as a class, he is probably more interested in getting things done than in getting rich, should be a great asset. In the past, engineers have unfortunately tended to take the side of the wealthy and employing classes as against labor. It is time to lay aside all prejudice, all faith in shibboleths, and all fear of words like "socialism" and "bolshevism," and to make an open-minded study of the facts.

RALPH W. POWELL, M. Am. Soc. C.E.
Assistant Professor of Mechanics
Ohio State University

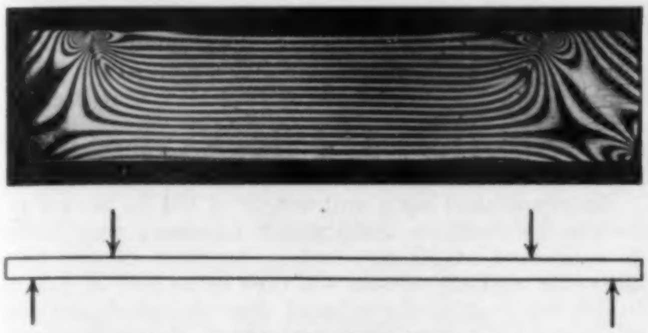
Columbus, Ohio
April 11, 1932

Photo-Elastic Model in Pure Bending

TO THE EDITOR: The article by Professors H. J. Gilkey and E. O. Bergman on "Supplementary Methods of Stress Analysis," in the February issue, contains a brief reference to the photo-elastic method. In commenting on Fig. 3, the authors say "the stress distribution in Fig. 3 appears to be in close agreement with that determined by the theory of flexure, except near the concentrated load, where local stresses plainly show." In my opinion this comment is erroneous. The photograph shows one fundamental divergence from the ordinary flexure theory. Attention is called to the total ab-

sence of a neutral surface. Had there been a neutral surface the central part of the beam would show a straight black fringe similar to the one in the illustration accompanying this letter. Instead there is a fringe of the order of approximately $2^1/_2$. By fringe of order is meant the number of times a particular point darkens during the application of the load.

The only case of bending in which the results from the elementary engineering theory agree with those from



Bakelite Beam in Pure Bending

photo-elasticity is the case of pure bending, in which the fringes are seen to be straight, parallel, and equidistant lines, as here shown. These characteristics of the fringes follow directly from the flexure formula which, for the case of pure bending, represents an exact solution.

M. M. Frocht
Associate Professor of Mechanics
Carnegie Institute of Technology

Pittsburgh, Pa.
April 11, 1932

Note: The two figures referred to in the original article and the illustration accompanying this letter are from a paper by Professor Frocht in the Proceedings of the American Society of Mechanical Engineers, Vol. 53, No. 15 (1931), entitled "Recent Advances in Photo-Elasticity."

Obsolescence and the Rate Base

To the Editor: The paper by Mr. Black on the "Present Status of Valuation Procedure," in the March issue, was especially illuminating to me as a statement of certain definite problems. These are of direct interest to the utility operators, their customers, and those seeking adjustment of national public policy.

Courts and commissions concede the importance of investment, historical cost, and other pertinent elements but hold that reproduction cost of the complete property, in its actual physical state, on the exact site occupied as of a given date, shall be the determining factor in the rate base. Piecemeal construction is generally the result of keeping pace with the growth of the area served. Inadequacy, or need of adjusting physical property to the requirements of the area, has no place in depreciation. It is a part of obsolescence which should be recoverable through earnings and written off.

"Going-concern value" is like conversation and, to a large extent, dependent on it. It can never be recovered except through earnings produced by it and should be amortized with reasonable promptness. Neither excess cost through piecemeal construction nor going-concern value can suffer depreciation, which is "generally treated as a lowered capacity for service." The capital in these two items should be recovered, the rate base reduced if necessary, and the national interest of conservation of capital resources served.

When a property is transferred by sale, there is no apparent excuse for altering the rate base or authorizing the purchaser to issue additional securities. The market price of a property or securities is dependent on the current interest rate and not on the cost of reproducing a specific property or an adjudicated rate base.

Recent studies in Latin America and Great Britain have induced in me a new point of view regarding obsolescence under conditions in countries much younger or much older than ours in an industrial sense. In those countries, and in ours, there is ample evidence of fallacy regarding the permanence of investment safety. It is believed that lack of substantial reserves for obsolescence has impaired the security of investments to an extent greatly impeding the march of progress.

I like to think of depreciation as a lessening of price or exchange value, with reference to cost or face value, due to "inherent vice," or the material quality of things inevitably subject to destruction by the elements and use. Obsolescence appears to be a similar lessening of value, but due in this case to the service quality of things, or states of being, in high probability subject to disuse and effacement through changes in the arts, economic conditions, and human desire. Obsolescence is predictable unless we concede that the status quo is immutable. Invention is no longer accidental; to an unusual degree it is planned in great laboratories. The patent office, the scientist, and the technologist read a generation's change in handwriting on the wall.

The institution of American slavery became obsolete with the invention of the cotton gin. Investment in slavery continued for seventy years. The horizon of railway earnings was circumscribed by fuel oil, pipe lines for oil, gasoline, and natural gas, which first struck the coal mines and then the railways with double force. The automobile struck the railway and the wagon maker. Many years were required for these things to develop. We cannot predict what hybrid seed may appear. We can predict that sprouted seed will probably bear fruit. It is only with the use of the mass of existing data that the prediction of obsolescence is proposed.

In so far as public utilities are concerned, it is suggested that reserves for obsolescence be substantial and be carried alive in the non-resalable mortgage debt of the company. From time to time they should be written off through piecemeal cost excess, franchise cost, going-concern value, finance discounts, possibly other deferred assets; and, when apparently necessary or desirable, through property and the rate base.

Verne L. Havens, M. Am. Soc. C.E.
Consulting Engineer

New York, N.Y.
May 1, 1932

Combating Leakage in Concrete Dams

Dear Sir: The article by Mr. Reed in the April number provides abundant proof of the necessity for designing dams on conservative principles, especially when such dams are exposed to severe climatic conditions. An equally important requirement is that the highest and strictest standard of workmanship be maintained throughout the whole period of construction.

Evidently in the case of the Ringedalsvand Dam proper precautions were not taken to ensure the bonding

of new concrete to old. The leakage through this dam is given as having been 8,000 acre-ft. in 1928. Expressed in terms of supply, this represents 6 million gallons per day. Since no figures of the cost and capacity of the reservoir are given, it is impossible to estimate the capitalized value of this enormous leakage, but it is probably not less than a million dollars. That considerable extra expense would have been justified during construction to ensure against excessive leakage is sufficiently emphasized by the fact that it was necessary to rebuild the dam after a useful life of only 11 years.

The very severe climatic conditions under which these dams operate are, of course, responsible for the rapid disintegration that has taken place. Ice pressure in the cracks and pores of the concrete has a very quick and destructive action, which is assisted by the solvent action of the water, particularly if humic acid is present. Under these conditions, everything depends upon the prevention of initial ingress of the water into the concrete, or at least upon minimizing the quantity.

Experiments carried out at the Building Research Station in England by the Department of Scientific and Industrial Research (*Technologic Paper No. 3*, "The Permeability of Portland Cement Concrete") show that the permeability of a 1:2:4 mix of concrete cured in air and tested at 28 days is approximately 40 times as great when made with ordinary portland cement as when made with either rapid-hardening portland cement or a high aluminous cement. This important result shows the immense superiority of rapid hardening cements for water-retaining structures.

In a paper published in *Transactions of the Institution of Water Engineers*, Vol. 33 (1928), on the effect of moorland water on concrete, Messrs. Halcrow, Brook, and Preston show that high aluminous cement is much more resistant to the action of acidic water than is ordinary portland cement. A sample of concrete made with aluminous cement was practically undamaged after being in contact for 1,800 days with acidic moorland water. The acid was probably chiefly humic. A sample of concrete made with ordinary portland cement showed severe deterioration after 270 days immersion in similar water. The authors also state that, "Concrete made with rapid-hardening portland cement is better than ordinary portland cement but probably is not so good as aluminous cement."

It would therefore appear that where neutral or slightly alkaline waters are to be retained there is little to choose between rapid-hardening portland cement and aluminous cement. Where the water is acidic the aluminous cement is best, and in either case both cements are superior to ordinary portland cement.

To build a dam of rapid-hardening portland cement instead of ordinary portland cement would mean increasing the capital cost by 20 per cent of the cement bill, and if aluminous cement were used the bill would be doubled. In the latter case there would also be the additional expense of the extreme care needed to prevent shrinkage cracks. If the use of these cements, however, will materially decrease the rate of deterioration, then it is clear from the example of the Ringedalsvand Dam that the additional expense is warranted.

A. K. POLLOCK, Assoc. M. Am. Soc. C.E.
Assistant Resident Engineer
Scout Dike Reservoir
Barnsley Corporation Waterworks

Barnsley, Yorkshire, England
May 2, 1932

Reducing Specific Weights of Concrete

TO THE EDITOR: In discussing the possibility of concrete arch spans up to 5,000 ft. in length, in the February number, M. Freyssinet rightly attaches much importance to the reduction of specific weight. Without a limitation of dead load, concrete can scarcely compete with silicon, nickel, and other high grade steels now available in structural steel construction.

There are possibilities in reduction of specific weight with concrete strengths less difficult of attainment than those suggested by M. Freyssinet, if longitudinal reinforcement is employed. In studies made for a project in which span lengths of between 1,400 and 2,400 ft. were deemed desirable, I arrived at specific-weight equivalents of ordinary carbon and silicon structural steels in the following manner:

Structural steel has a unit weight of 490 lb. per cu. ft. Details for built-up compression members may fairly be estimated at 50 per cent. The ratio of the unit allowable working stresses will then be as (490×1.5) is to the unit weight of reinforced concrete, which, making allowance for a maximum percentage of reinforcement and for protective covering outside the reinforcement, may be taken, for example, at 224 lb. per cu. ft.

A recent specification allows, for compression members of ordinary carbon structural steel, a maximum unit working stress of 14,000 lb. per sq. in.; and for silicon steel, a maximum of 18,700 lb. per sq. in. The specific weight equivalents in reinforced concrete of these unit working stresses would therefore be:

$$\frac{14{,}000}{490 \times \dfrac{1.5}{224}} \text{ or } 4{,}270 \text{ lb., and } \frac{18{,}700}{490 \times \dfrac{1.5}{224}} \text{ or } 5{,}700 \text{ lb., respectively.}$$

If in the American Concrete Institute formula for hooped concrete columns,

$$\frac{P}{A} = [1 + (n-1)p]\,[300 + (0.10 + 4p)f'_c]$$

where f'_c = unit ultimate compressive cylinder strength at 28 days, we use (1) values of n in line with actual values of the elastic modulus of high strength concretes, say $n = \dfrac{E_s}{1{,}500{,}000 + 500f'_c}$; and (2) 10 per cent of the longitudinal reinforcement, then the permissible unit working stress for 5,000-lb. concrete becomes 4,620 lb. per sq. in., and for 7,000-lb. concrete 5,700 lb. per sq. in. Incidentally, the latter quantity meets the requirements, as stated by M. Freyssinet, for a 4,920-ft. arch span.

While this column formula was intended to apply to the lower strength concretes and to percentages of longitudinal reinforcement not greater than six, data recently reported in the institute's journal indicate its applicability to concrete strengths of 7,000 lb. per sq. in. or more and to percentages of longitudinal reinforcement as high as ten, provided the longitudinal steel has a yield point of, say, twice its normal working unit stress and that the ratio and spacing of the hooping are such as to ensure the full yield point of the longitudinal steel being developed. Normal stress is exclusive of shrinkage and other non-elastic increments.

M. Freyssinet's proposal to raise the ultimate prism strength of 20,000-lb. concrete to 70,000 lb. per sq. in., or by three and one-half times, through the use of transverse reinforcement as strong as 200,000 lb. per sq. in., does not appear feasible. It fails to take into account that

the elastic modulus of the hooped concrete for unit stresses above the ultimate strength of the concrete alone is that of a (partially) confined granular mass without appreciable tensile integrity and therefore so low as not to justify an increase of working stress proportional to the increase of ultimate strength furnished by the transverse reinforcement.

To reduce the specific weight of concrete much below that of ordinary carbon and silicon structural steels also appears futile since a correspondingly reduced cross section would bring into prominence local eccentricities and consequent buckling or crippling tendencies.

Gilbert C. Staehle, Assoc. M. Am. Soc. C.E.

Indianapolis, Ind.
May 5, 1932

Drainage Difficulties Met with in Subway Work

To the Editor: In your March issue, Mr. White's reference to the provision for the care of groundwater is worthy of the designer's consideration. During the excavation of a subway in most types of ground the immediate static head of the groundwater is virtually eliminated, because the water is drained back on some sort of a natural slope within the ground material along the sides of the trench. In this condition the amount of subsequent leakage into the subway trench is merely determined by the rate of percolation through the local material. Any form of under-floor or outer side-wall drainage that would maintain this condition created during excavation would require the least amount of automatic pumping from sumps. In the fine sands found in the vicinity of Maiden Lane in lower Manhattan Island, any under-subway drainage system is subject to clogging from the materials brought into the drains. Or if drain clogging does not occur, the free passage of fine materials in suspension in the drainage water will tend to create an unsafe condition by robbing the surrounding ground of material after the structure is built.

If the system of drainage and pumping used in the Philadelphia subways were employed in many of the coarser sands in Manhattan, Brooklyn, and Queens, it might result in a distinct saving over the cost of all the items involved in the fully waterproofed design.

The preparation of special outer walls and subfloor bottom for the waterproofed type of structure is at best a difficult task, and the effectiveness of the waterproofing depends in turn on making water-tight laps, often in close working quarters. During the building process the accumulating load of the structure upon and against the waterproofing must by force adjust itself in accordance with the bearing value of the soil foundation. In reality, what might otherwise be a good waterproofed job might conceivably be ruptured by movement of the structure before it is completed or even after the operation of trains begins.

Leaks do occur even in waterproofed subways, and they continue because the subway is constructed as an otherwise tight dam, and the water head therefore rebuilds itself to the height it maintained before excavation was started. Drains, sumps, and automatic pumps are provided to take care of this leakage. If it were specified that the subway walls and floor concrete should be made from the higher grades of cement recently developed to produce denser concrete, and that much of the waterproofing should be omitted, I doubt if there would be very much more leakage, proportionately, than there is at present. From an economic standpoint, it might be better to use these higher grades of cement and provide water-stops at joints.

In his reference to "bulbs of pressure" in connection with foundation design, Mr. White has opened up another subject of interest to designers. In the case of the four-track design, the pressure curves would be relatively smaller in wave length and would more nearly approach the uniform line of distribution than do the curves for the box type considered by Mr. White.

If, in the design of the side-wall and interior-column footings as well as of the intermediate floor, account were to be taken of these varying load pressures in detail, the subway subgrade would have to be dug to correspondingly varying elevations. Present tendencies in design incline too much in that direction, and I believe that certain soil values are destroyed as a result of the attempt to excavate in accordance with these irregularities. In whatever way the varying load conditions may be taken care of in detail, I feel that the subgrade should be as far as possible on one plane. Simplification in all directions makes for good design, for structures must be built as well as designed. One design may be considered preferable to another even though it calls for a structure of greater volume, merely because its simplicity tends to lessen the cost of construction. Economy, then, is not measured solely in cubic yards.

Herbert M. Hale, M. Am. Soc. C.E.

Brooklyn, N.Y.
April 28, 1932

Design and Construction of Subways in New York

To the Editor: In connection with Mr. White's article in the March issue, there are several points that should be touched upon further—spread foundations, elimination of waterproofing, and construction of subways without jack arches. As a result of my experience 35 years ago on the New Haven Railroad, I am a firm believer in spread foundations. On this project I had to construct an arch under the railroad, just east of the present Pelham Station, on the New York Branch, through Mt. Vernon, N.Y. The arch was in the shape of a five-centered ellipse, with a 40-ft. span and a 6-ft. rise. One foundation was on solid rock, and the other on soft ground—a condition usually avoided in arch construction. But my instructions were to build an arch if possible.

The westerly foundation, on solid rock, was built of neat masonry, but the easterly one, on soft bottom, was spread, and there was ample time for settlement before the arch was sprung. That was thirty-five years ago. The arch today is carrying a load double that for which it was designed, and there is no sign of a crack. The spread foundation was thoroughly efficient.

Another point is in connection with the design of subways without jack arches. This method was employed for the subway along Fourth Avenue, Brooklyn, because of difficulties, at the time, with labor on iron erection. Since they threatened to delay the work, the use of jack arches was avoided. The subway was designed of reinforced concrete throughout—top, bottom, and sides, as well as partition walls. It was reinforced vertically and longitudinally—longitudinally to avoid expansion joints, as the variation in temperature would

be comparatively small. Jack arches were omitted in spite of their convenience, demonstrated by my experience on the old subway along Fourth Avenue, Manhattan.

Conditions of temperature rather than motives of economy prompted the elimination of waterproofing from the structure. Bituminous waterproofing had prevented proper radiation of heat from the old subway, so that in hot weather it was some 5 deg. warmer than the outside air, and was unbearable. At the time of construction, waterproofing was eliminated even from the roof in order to obtain all possible radiation. This step was taken as the result of the experience in the construction of the old subway along Fourth Avenue, Manhattan. The subway at 17th Street had been completed and backfilled, when a heavy leak occurred. The street was dug up, the subway re-waterproofed, and the street repaved. After this experience had been repeated three times, I suggested to my contractor that a blind drain be laid on the roof to the edge of the subway. This was done, and there was no further difficulty. So when it was decided to omit waterproofing on the roof of the subway along Fourth Avenue, Brooklyn, 6 in. of broken stone was substituted for it. This costs about the same as the eliminated waterproofing, but gives increased radiation.

When the subway along Centre Street, Manhattan, was built about 1908, it crossed the site of the old Collect Pond near Worth Street. The peat was removed but no piles were driven for support at this place. Piles, however, were sunk at Canal Street to make provision for a possible future subway crossing at a lower level. I made these piles of pipe casings filled with concrete, and believe, as Mr. White notes, that this was the first time that steel piles were used in subway foundations.

These experiments, which have been entirely successful, are only a few of the changes made in subway design in the years from 1907 to 1910.

HENRY B. SEAMAN, M. Am. Soc. C.E.
Consulting Engineer

Brooklyn, N.Y.
April 28, 1932

Appreciation of the Beauties of the Pont du Gard

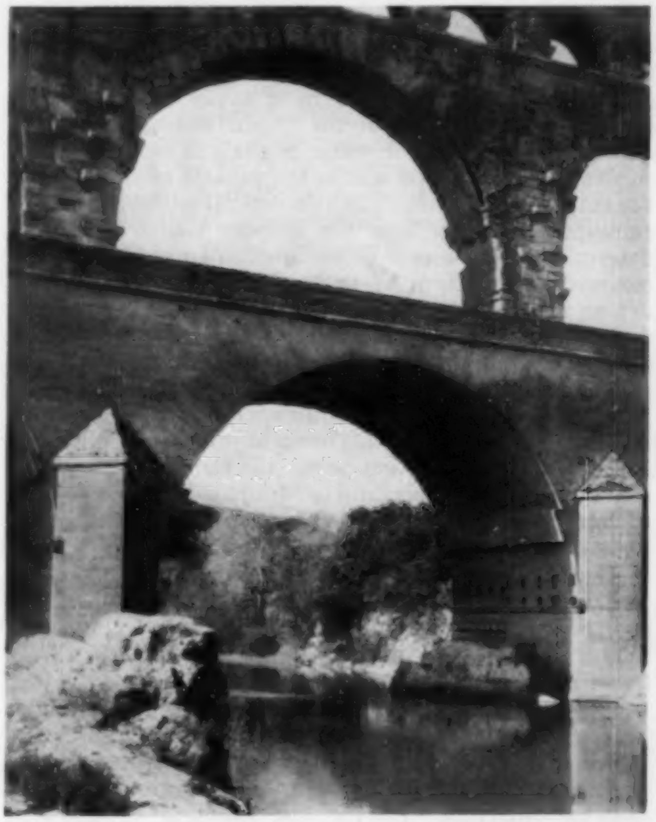
TO THE EDITOR: In his article in the February issue Professor McKibben says that the Pont du Gard "is as near poetry in a material form as stone can be." In this connection it may be of interest to give a free translation of part of an article in *L'Illustration* for February 6, 1932, in which Emile Henriot describes an artist's reaction to this famous engineering structure.

"This impression of solidity, of calm and tranquil power, which [at Nîmes] communicates to the blasé spirit of the tourist an invigorating sense of force, of balance, and of reason, is given above all by the Pont du Gard. It is to be hoped that those who visit Nîmes for the first time will come by way of Avignon so that, at the price of a very short detour, they may discover this unparalleled structure, as we did, by surprise. It is useless to suppose that because one has been forewarned, so to speak, of the beauty of this masterpiece, that its effect will be any the less. The surprise will be overpowering, and one will be unable to suppress a cry of delight.

"At the turn of the by-road that zigzags under the branches, through fresh and well-watered verdure, the gigantic bridge suddenly appears—an immense structure bounding with long leaps over the Verdon. Between its banks of sand, the little river appears startled to find itself the pretext for such leaps.

"The bridge has two stories and three levels of superimposed arches. It is two thousand years old and it is still in service, as a footbridge now instead of an aqueduct. It is composed of enormous blocks of stone laid one upon another without cement and held immovable by their own weight. Yet "immovable" seems scarcely the word to apply to the Pont du Gard, so active, alert, and breathing does this monument appear, its arches leaping across the sky, the earth, and the water—a dynamic force giving to its endeavor a kind of easy and bounding grace.

"It is a giant, at the same time human and monstrous, massive, endowed with eternity, wearing its grandeur and its strength with an incomparable elegance. In the sun the stone appears golden, in the evening reddish, and in places touched with a blood-red. There is nothing flimsy, nothing tawdry about it, not the smallest in-



THE PONT DU GARD, BUILT DURING THE FIRST CENTURY B.C.
The Upstream Half of the Arch Supporting the Highway Is Modern Construction

consequential detail to distract the eye from the ensemble. Its sublime beauty—a certain completeness and finished perfection—considered as the work of man, at first provokes astonishment, but soon gives the true intellectual enchantment that architecture creates.

"This edifice bears itself so well; it is logical, agile, audacious, and sure of itself, of its firm foundation, of its immovable base. These arches like strophes engendered one from the other, this sobriety, this vigor, this perfect proportion from base to summit, and this line so clearly defined, which, on rolling jambs, crowns the monument with one sweep and seems to give to it a new reversed support on the firm cobalt of the sky, against which it

stands out pure and definite. Such a result embodies equally geometry and music—rhythm and precision. There is perfection in the whole."

William K. Hatt, M. Am. Soc. C.E.
Head, School of Civil Engineering
Purdue University

Lafayette, Ind.
May 8, 1932

Adaptability and Beauty in Bridges

To the Editor: In the article, "Poetry and Bridges," in the February issue, I was critical of poor design of bridges and set forth some attainable esthetic ideals. To possess adaptability, a bridge structure must satisfy human wants, must be adequate in strength to carry all loads and traffic required by present needs or by those of a reasonable future, and must be reasonable in cost. In brief, it must have a reason fcr being, must possess strength and be economically sound. But is this enough? For some few locations, yes; for others, undoubtedly no.

When is beauty so desirable a feature in bridge construction as to justify in its acquisition the expenditure of public funds? Clearly, when the existing or proposed attractiveness of a location demands that esthetics as well as adequacy be given appropriate consideration. In one instance, harmonizing the bridge with its environment may justify a large expenditure, while in another rare case additional cost for beauty may be unjustifiable.

Certainly, in the construction of public as well as private buildings, large sums are expended for the sake of beauty. Although it is certain that public funds should be wisely, economically, and honestly spent, it is not always simple to determine for a particular bridge how much should be expended to give it a pleasing appearance. Where the construction of a new bridge adds great value to the aggregate of existing properties, it is relatively easy to justify the cost; and although it must be acknowledged that, in some locations, a beautiful bridge would increase the value of property more than would an ugly one, determination of the exact amount of justifiable expenditure is clearly impossible.

It was Ralph Waldo Emerson who said:

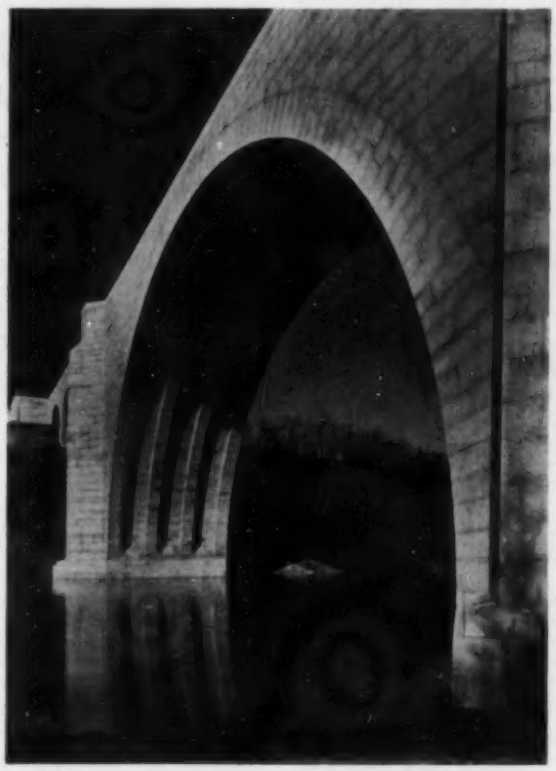
> If eyes were made for seeing,
> Then beauty is its own excuse for being.

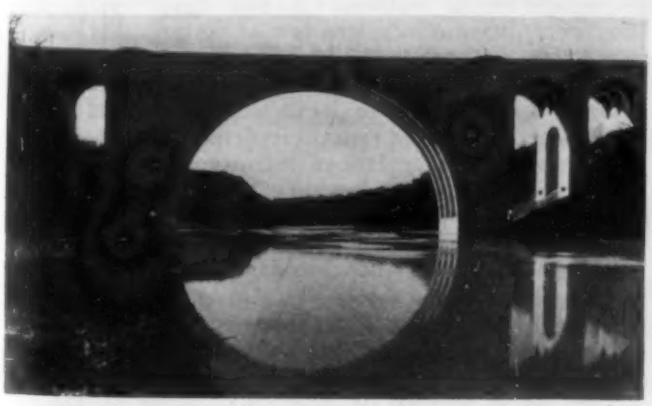
However, the attainment of beauty is not always a matter of additional expense, but rather one of harmonious proportions and lines.

The recently completed Veterans' Memorial Bridge at Rochester, N.Y., spans the wonderful Genesee River gorge in the city of Rochester, connects the two beautiful parks and residential areas that make both sides of the river so attractive, and renders large areas of land accessible to those who wish to utilize them. This location clearly demands a bridge of beauty as well as utility.

The chief structural features of the bridge are a central semicircular span of 300 ft., flanked on each side by three arches varying from 50 to 58 ft.; solid spandrels; "filler" walls between the arch ribs; and stone facing on the principal exposed surfaces of arches, piers, and abutments. The modern reinforced concrete skeleton is covered by solid spandrel and "filler" walls, thus creating a bridge characteristically Roman in appearance. This similarity to ancient classic designs is heightened by wide piers, semicircular arches, and curved, instead of stepped, extradosal treatment of the voussoirs. In the Veterans' Memorial Bridge, an attempt has been made to satisfy the requirements of both adaptability and beauty.

Among those representing the city of Rochester on the project were Harold W. Baker, M. Am. Soc. C.E., Commissioner of Public Works; and





The Veterans' Memorial Bridge, Rochester, N.Y.
Photographs Were Taken by Samuel H. Gottscho, Jamaica, N.Y.

Edwin A. Fisher, Hon. M. Am. Soc. C.E., and C. A. Poole, M. Am. Soc. C.E., engineers. Besides these and many others, the following also contributed to the successful completion of the work: Richard de Charms, M. Am. Soc. C.E., resident engineer; Meyer Hirschtal, M. Am. Soc. C.E., designer of the reinforced concrete; L. H. Shoemaker, M. Am. Soc. C.E., designer of the preliminary studies in steel; the firm of Gehron and Ross, architects; and the Booth and Flinn Company, contractors. I was the engineer in charge of design and construction.

FRANK P. MCKIBBEN, M. Am. Soc. C.E.
Consulting Engineer

Black Gap, Pa.
May 1, 1932

Statistics Favor Bridges

TO THE EDITOR: Referring to the article "Tunnels or Bridges—Which?" in the February issue, Mr. Frankland's conclusions as to the superior economy of bridges per traffic lane appear to be conservative. In such cost comparisons, insufficient credit is generally given to large bridges for their additional facilities. In the case of the Philadelphia-Camden Bridge, the 6-lane roadway contributed only one-third of the total design load, so that the provision of 4 tracks and 2 sidewalks should properly be credited as equivalent to 12 additional highway lanes in cost-producing effect. (Instead of this equivalent total of 18 lanes, Mr. Frankland very conservatively assumed only 10.) Similarly, the George Washington Bridge should be credited with more than its immediate highway capacity. The present cost of the structure already includes, in towers, cables, and anchorages, the cost-effect of the lower deck to be added later; and when this second deck is added, the total capacity will be at least 8 traffic lanes, 4 rapid transit tracks, and 2 wide sidewalks, equivalent in cost-effect to a total of 20 highway lanes or more (instead of the 12 lanes conservatively assumed by Mr. Frankland in his comparison).

Very properly he called attention to the capitalized cost of the greater operating expense of tunnels. The operating cost of tunnels, on account of ventilation, lighting, and policing, is about four times as high as the operating expense for bridges of the same total first cost. The difference is equivalent to the interest on from $20,000,000 to $40,000,000 for the tunnels under comparison, and this amount should be added to the tunnel cost when comparing a bridge with a tunnel.

Total cost per traffic lane is the only fair basis for economic comparison, since there is no inherent reason why tunnels should have greater traffic capacity than bridges per traffic lane. At the cost of drastic regulation of vehicle types, movements, spacing, and speeds, the Holland Tunnel has attained a peak record of 59,000 cars on its 4 lanes in one day; but the Queensboro Bridge, without such regulation, has carried a daily traffic of 99,000 cars on a 6-lane roadway of less modern design. If there is any advantage, it is in favor of bridges because, as pointed out by Mr. Frankland, their wider roadways give greater flexibility for adjustment of lane divisions for prevailing directions of traffic. Furthermore, a single car accident will paralyze tunnel traffic.

Any differences in cost of approaches are already included in such economic comparisons as Mr. Frankland has presented. The long-time effect on abutting property values will depend, in either case, upon the approach design and upon local conditions. It is not fair to compare the approaches of a modern tunnel with those of a bridge designed and built a half-century ago. During the intervening decades, the engineering profession has made great strides in the science and art of planning. Instance after instance can be cited where bridges have tremendously enhanced values of adjoining property.

Lest an erroneous impression be produced by Mr. Frankland's article, it should be pointed out that bridges do not have to be designed for more traffic lanes in order to be more economical than tunnels per lane. Even a two- or four-lane bridge can exceed a tunnel in economy. If a wider bridge is planned, it is because the designer anticipates corresponding traffic requirements; and the designer of a modern bridge or tunnel is fully alive to the problem of traffic handling and effective terminal design. Witness the approach planning for the George Washington Bridge.

D. B. STEINMAN, M. Am. Soc. C.E.
Consulting Engineer

New York, N.Y.
April 27, 1932

Pros and Cons of Model Analysis

DEAR SIR: Reference is made to a communication in your issue for April, entitled "Wrong Conception of a Principle of Elasticity." Mr. Janni establishes a certain relationship by means of the principle of reciprocity, and then proceeds to indicate that the principle cannot be used as a basis for developing the theory of mechanical stress analysis except by making certain approximations.

In my opinion he is absolutely correct in this statement. In fact, he goes on to clinch his argument by pointing out with unerring mathematical logic that the only force which can possibly produce pure vertical displacement without rotation at point B would have to act through the elastic center of the arch and along that axis of its ellipse of elasticity whose conjugate was horizontal (a vertical axis in the case of symmetrical arches).

The profession is indebted to Mr. Janni for having first introduced the ellipse of elasticity as a structural working tool in American practice, and his writings have done much to clarify our concepts regarding elastic displacements. For this reason any statement by him should carry considerable weight with American engineers. In the present instance, however, I am inclined to take issue with his ultimate conclusions.

If he is simply voicing an objection to the ordinary method of demonstrating the principles underlying mechanical stress analysis, I can agree with him absolutely, inasmuch as the law of reciprocal displacements alone will not suffice for a rigorous demonstration; but not, on the other hand, if he seeks to question the accuracy and reliability of the mechanical method itself.

This theory may be rigorously demonstrated entirely independently of the law of reciprocal displacements. In fact the writer and Edward S. Thayer, on page 271 of their book, *Elastic Arch Bridges*, have given just such a proof. That demonstration anticipates the very objections raised by Mr. Janni, and shows that while the ordinary proof neglects certain restraining forces, exactly as stated by Mr. Janni, nevertheless no error is introduced in the results because of the fact that these forces perform no work.

The model method is especially useful in that it furnishes a visible and tangible check on algebraic methods. I feel that American engineers are inclined

to be unduly antagonistic to it. Without forsaking the tried and proved mathematical methods of attack, the mechanical method may well be adopted as an additional tool. Its use and development should be encouraged.

C. M. McCULLOUGH, M. Am. Soc. C.E.
Bridge Engineer
Oregon State Highway Commission

Salem, Ore.
April, 13, 1932

Mathematics Check Model Analysis

DEAR SIR: A letter by Mr. Janni in the April issue questions the basis of the model method of structural analysis which has come into wide use by engineers in the solution of highly indeterminate structures. The engineering schools of several universities are now teaching their students these principles as part of their structural course. The profession is therefore deeply interested in the confirmation or refutation of Mr. Janni's argument.

Engineers of the Westchester County Park Commission have designed several arch bridges for which stress analysis was made by the mechanical method. In several cases this analysis was supplemented by mathematical calculation, and the results of the two methods always agreed almost precisely. The cases so analyzed were for single span, twin-span, and unequal double span.

The most satisfying demonstration of the correctness of the mechanical analysis lies in the fact that the results can always be checked on the model itself—by loading it with actual loads and holding it in equilibrium by strings following the line of action of the reactions as determined by the analysis. If the forces balance, the analysis must be correct. Such a check has been made so many times that there seems to be little room for doubt. We have in addition satisfied ourselves as to the correctness of the fundamental principles by direct mathematical proof. In so far as Mr. Janni's proof is concerned, the designers of the Westchester County Park Commission are not satisfied with his equation, $1 \times \delta' = H' \times \Delta s$, which is given without proof. We therefore think that there is a fallacy in his reasoning which begins right at that point.

ARTHUR G. HAYDEN, M. Am. Soc. C.E.
Designing Engineer

Bronxville N.Y.
April 25, 1932

Defense of Model Methods

SIR: I do not pretend to question the accuracy of A. C. Janni's statements in your April issue, but knowing them to be directed against model statics in general I wish to say that in this attitude he is in error. To start with, correct mechanical analysis by means of model deformations is eminently a geometrical problem. In order to obtain mechanically the correct reaction of the arch treated by Mr. Janni, a unit geometrical displacement would have to be applied at B in any one direction at a time, producing displacements at all other sections where, incidentally, forces may act. To apply for the purpose a force at B is precisely as inadmissible as it would be to express a distance in pounds, and reasoning on that basis must needs lead to wrong results. Mechanical analysis, being but a reproduction of what does or may actually happen in structures, cannot be wrong when correctly appl.ed.

Up to now the subject of statics has been largely treated upon entirely abstract and artificial assumptions without the necessary experimentation, which is the logical basis and guide in developing theories in natural science generally. This artificial, abstract conception is responsible for hopelessly complicating results for all but the very simplest symmetrical structures. The logical and the only possible method of creating a sound basis for natural statics is to interpret by correct experimentation the ways in which nature itself indicates that the structure will act. It leads to surprising results, as I have been able to show.

Certainly Mr. Janni's contribution should be welcomed inasmuch as it emphasizes the importance of having operations in mechanical analysis agree with actual conditions of structures. This, by the way, generally is easier to obtain in a model than in abstract calculation. I should strongly advise, however, against judging natural concrete methods with the usual abstract conception, as proposed by Mr. Janni and numerous authors before him, which is turning statics more and more into a huge unmanageable bulk of learned tricks instead of the organic, useful aid in practical work it should and will be, once the natural principles are generally understood and applied. That, however, requires patient rebuilding of statics from the bottom. Arches, in my experience, are not appropriate to start with.

OTTO GOTTSCHALK

Buenos Aires, Argentina
April 25, 1932

Reciprocal Deflections by Virtual Work

TO THE EDITOR: In the April issue, Mr. Janni questioned by letter the validity of the particular application of the elastic theory to the solution of statically indeterminate reactions by a mechanical analysis. The error in his reasoning may be most easily shown, I believe, by the application of the principle of virtual work to the example of a fixed-end arch presented in his discussion.

Consider the fixed-end arch in Mr. Janni's Fig. 1*a*. When the support at end B is removed so that it can be considered free as he suggests, the boundary conditions may be replaced by a vertical force V, a horizontal force H, and a fixing moment M. Now give B a virtual vertical displacement, δ_1, in such a manner that there will be no horizontal movement or rotation of the end B. A virtual displacement is any displacement independent of the actual forces acting on the arch. Designate by P, Mr. Janni's "force applied at C," this force having a virtual displacement in the direction of its line of action denoted by δ_2.

Making use of the fact that the total virtual work must be equal to zero, the following equation is obtained:

$$(H \times O) + (M \times O) + P\delta_2 + V\delta_1 = 0 \ldots\ldots [1]$$

Solving Equation 1,

$$V = -P\frac{\delta_2}{\delta_1} \ldots\ldots\ldots\ldots\ldots\ldots [2]$$

The minus sign in Equation 2 merely means that the displacement δ_2 must be of opposite sense to that of the load P if δ_1 is of the same sense as V. Equation 2 is identical with Equation 1 of Mr. Janni's letter which he claims is "fundamentally wrong."

In the development of his Equations 2 and 3, he has evidently neglected the work done by the moment M when the rotation of the end B is not prevented. The

term containing M in my Equation 1 would not be equal to zero unless the rotation of the end B was made zero during the vertical displacement. The values for H and V determined by Mr. Janni would be those for an arch fixed at the end A and hinged at the end B. It is true that the reactions H and V may be considered as acting at the elastic center of the arch. To do this, however, it would be necessary to displace the end B by movements given to the elastic center. This would not be practical for a mechanical analysis. Subject to all the limitations that the elastic theory itself may have, the method of mechanical analysis is fundamentally sound.

T. P. NOE, JR., Jun. Am. Soc. C.E.
Instructor of Civil Engineering
The University of North Carolina

Chapel Hill, N.C.
April 26, 1932

Apply Reciprocal Deflections Correctly

SIR: I was interested in the conclusions drawn by Mr. Janni, in the April issue, with regard to the theorem of reciprocity. His Equation 1 remains fundamentally correct and accurate provided the following proper definitions are attached to the symbols:

> δ_1 = a displacement in the direction of the vertical reaction at B under the condition that the end B is not allowed to rotate or to move horizontally.
>
> δ_2 = the deflection in the direction of the load acting at C kinematically connected with δ_1.

In the application of the reciprocal theorem we have two fixed directions, not necessarily identical, and two forces acting in these two directions. The reciprocal theorem then gives a relation between the deflections in these directions due to forces acting singly in these directions. Mr. Janni seems to have ignored these restrictions in deriving his equation:

$$1 \times \delta' = H' \times \Delta s$$

He starts with a deformation, as shown in Fig. 1*b*. His two directions are: (1) vertical at C, and (2) along BB' at B.

A deformation is then given to a structure (Fig. 1*c*), which differs from that of Fig. 1*b* from the point of view of kinematical freedom and statical determination. A new direction and a new force are brought in, that is, Δs and H. A relation is then set up between (1) δ', a vertical displacement which corresponds to a movement along BB' (Fig. 1*b*); (2) H', the horizontal component of a force which causes a movement along BB' (Fig. 1*b*); and (3) Δs, a horizontal displacement which corresponds to a pure horizontal movement (Fig. 1*c*).

These displacements and forces, corresponding to three different directions, are therefore erroneously connected by his equation. It follows that the equation:

$$H' : H = \Delta' s : \Delta s$$

is only valid when the conditions under which the two movements and corresponding forces are measured, are identical.

I. K. SILVERMAN, Jun. Am. Soc. C.E.
Instructor in Civil Engineering
Massachusetts Institute of Technology

Cambridge, Mass.
April, 25, 1932

Mistaken Interpretation of Maxwell's Theorem

DEAR SIR: I have had opportunity to read Mr. Janni's interesting article in the April number and wish to take issue with him. The gist of his objections seems to lie in the following assertion: By the mechanical method the separated section or end of a structure is forced to move in a certain prescribed direction. As the deformation is consequently not free, because the section is held in a rigid position, the end is subjected not only to the force in whose direction it is driven and whose influence line is desired, but also to other secondary forces, eventually moments due to the forced deformation. Those associated influences are, however, not taken into consideration and hence the method is "fundamentally wrong."

For construction of the influence line of a certain force, he claims that it is necessary to expose the separated section, or detached end, only to the effect of the force in question, but otherwise to leave the end free, so that the displacement will not follow exactly the direction of the applied force. This is entirely in error.

In using Maxwell's theorem, a condition of the utmost importance is that the point of application of the force be submitted to only one sort of movement, that is, in the direction of the investigated force; every other component of displacement must be absolutely excluded. For instance, take the case in question of an arch fixed at both ends. Seeking the vertical reaction, we must drive the end B in a vertical direction only; no variation of the span and no change in the inclination of the end section are permitted. It is evident that such displacement cannot be "free," that is, caused only by a vertical force applied at the end B to keep the movement zero in other directions; rather the movement must be forced and obligatory. In other words, it is necessary to apply a certain moment and a certain horizontal thrust at the end B to carry it out. The same difficulty occurs with influence lines of a horizontal thrust H, or moment M_B at B.

Here is the root of Mr. Janni's misunderstanding. He is convinced that at the detached sections no other force can be applied but the force taken into consideration and that otherwise the movement must be free and unhindered. We maintain, however, the opposite and the correct viewpoint—the movement of the section of application is not free, but proceeds only in the direction of the force in question, whereas generally not only this force, but two other components are brought into action.

Of course, Mr. Janni's interpretation has its practical meaning; but, to speak in concrete notions of an arch, his case does not represent the influence line of a reaction of the supposed threefold statically indeterminate system, that is, of an arch fixed at both ends. It belongs to another system, with only one unknown force, an arch fixed at A and sliding freely on a horizontal straight line at B, where it may have only a vertical component of reaction. It goes without saying that the influence lines of these two different systems cannot be the same; in the former the horizontal thrust and the end moment must act, and in the latter case, they must disappear.

The experimental method does not need any long theoretical apologies. As a result of many interesting tests I have been amazed at the almost unbelievable coincidence of its results with exact theory.

JAN BLAZEK
Civil Engineer

Prague, Czecho-Slovakia
April 28, 1932

First-Order Geodetic Surveys

To the Editor: I should like to comment on certain items in the excellent paper on "Geodetic Control for North Carolina Highways" by Mr. Syme in the March issue.

Our Federal cadaster has charge of the surveying and valuation of public lands and of keeping a record of their improvement. It is not, however, a central agency for all information pertaining to surveys throughout the country, as is a cadaster in Europe.

All of Europe has, within the past 120 years, accepted geodetic control. Even in such distant corners of the continent as the Balkan States, geodesy has been adopted as a foundation for all surveying, whether it is an individual or a public project. South American countries have also introduced geodetic coordinates as control wherever it is possible to do so. I was personally privileged to test the high quality of geodetic work in Yucatan, and on international and interstate boundary operations in Mexico.

An engineer confronted with a geographical datum made up of degrees, minutes, and seconds, is ordinarily not prepared to make proper use of such information. He will undoubtedly be more familiar with a set of rectangular coordinates. It is, then, the conversion of geodetic data into rectangular coordinates that renders these data acceptable to the average engineer and surveyor.

An almost religious faith in the omnipotence of the time-honored method of chain-traversing apparently holds an overwhelming majority of the engineering profession in a state of hypnosis or paralysis. As a result of this condition, surveying proper, unlike other related branches of engineering, has scarcely advanced a step in this country for at least one hundred years. Barely half a dozen of our numerous colleges and technical institutes include geodesy and practical astronomy in their curricula. This explains the deplorable lack of knowledge, within our profession, of the meaning and value of geodesy. It is desirable, therefore, to create opportunities for enlightening students of engineering on the far-reaching importance of geodesy in municipal, state, and national planning.

A typical surveying case, on record with one of the most important park commissions in the State of New York, may be related because of its highly instructive nature. A chain traverse of 81,000 ft. linear development, showed the excellent closure of 1:175,000. Since it extended east and west in a narrow strip, a short diagonal line was run near the middle of the figure. The two parcels thereby created were then calculated separately, one giving a closing error of approximately 1:30,000 and of about 1:50,000, respectively. This diagonal doubtless stabilized the traverse and should always be taken into account. A further diagonal traverse, on the other hand, near the center line of either partial tract would not only have strengthened the figure, but may also have revealed a much lower closure for each of the four parcels thus originated, and the fallacy of "perfect closures"—so frequently experienced—might have come into evidence. The latter suggestion, however, was not sustained, and the closure of 1:175,000 found unhesitating acceptance, mainly because of its flattering disposition.

This decision, of course, merits severest criticism, professionally as well as ethically. The experiment confirmed the well known phenomenon that residuals tend to compensate one another. Let us assume an error of 5 ft. to have occurred inadvertently in this rather long traverse; the closure would then have been better than 1:16,000—a result which would plainly mislead an unprejudiced and too confident mind. The most detrimental result, however, may be expected from the conclusion complacently drawn by the judges—namely, that the high precision characteristic of first-order geodetic operations had been exceeded by simple traversing and that geodetic control was consequently unnecessary.

There are from 300 to 400 geodetic vertices on Long Island. The first of these was established about a century ago, and fifty years later there was one-half the number now in existence. Today, however, not one of these points is being used to full advantage by any engineer.

If the State of New York should wish to avail itself of the advantages afforded by modern methods of precise aero-photographic mapping, the great want of geodetic reference material north of Greater New York and Long Island would, throughout the state, present the most serious obstacle to an economic and efficient attainment of this purpose.

E. W. Albrecht

Babylon, N.Y.
April 23, 1932

Trigonometric Control Important

To the Editor: The paper by Mr. Syme on "Geodetic Control for North Carolina Highways," in the March issue, has been read with much interest. It shows advance in the right direction, and the state officials and engineers are to be congratulated upon this progressive work. Setting up a central bureau, or general mapping agency, is certainly a necessity if the data obtained are to be available to local engineers and others. This bureau should employ expert computers who can check all data received and make such calculations and adjustments as may be necessary to put the new work on the same basis as previous work. Such computers should have training in U.S. Coast and Geodetic Survey methods.

Judging from the proposed triangulation, as shown in Fig. 1 of Mr. Syme's paper, the second-order work planned by the Coast and Geodetic Survey will be a scheme with lines of from 10 to 20 miles in length, thus leaving many spaces of 40 miles or more between triangulation schemes. Even with lines as short as 15 miles on an average, there will probably be many places where towers will be required to overcome the earth's curvature, standing timber, and other obstacles. In order that such lines may be employed by future observers who wish to use the stations for expansion into new work, similar towers will be necessary, thus increasing greatly the cost of such work and often discouraging the local engineer from making such a connection. It is therefore very essential that more points with shorter lines be located at the same time, practically, as the second-order work.

If topographic maps are to be made, control points should be available at intervals of not more than 5 miles —and preferably at intervals of 2 miles—and many of these points may be located when the second-order work is being executed. If state engineers will erect properly marked signals, at all commanding points, visible from two or more of the second-order stations, and have them ready when the Coast and Geodetic Survey observers occupy their stations, these signals can be observed while second-order observations are being made, thus taking advantage of the large instruments

used by the Survey and probably not materially delaying their work.

It is the regular practice of the Survey to observe all objects which will be of use for future work, hence the Survey will probably be willing to do this extra work without additional cost to the state, or if objection is made the state may be able to arrange for such observations at cost. As the trained observers of the Survey can, with their large instruments, undoubtedly do this work more accurately and economically than local engineers, it will be good policy to have the work done in this way. In fact, any third-order work that the Survey may be prevailed upon to execute, even at the complete expense of the state, will probably be to the advantage of the state, as men not trained in the work probably would require more time and thus expend more money than the Survey men and, at the same time, not achieve as good results. Experience in this type of work is very essential if the best results are desired.

Another advantage of having the third-order work completed early is that the U.S. Geological Survey will be able to start the topographic maps sooner and thus make them available more quickly. My strong reaction in favor of the work of the Coast and Geodetic Survey results from 26 years' experience as a field officer in that service.

OWEN B. FRENCH, M. Am. Soc. C.E.
Professor of Civil Engineering
George Washington University

Washington, D.C.
April 28, 1932

Surveyors Value Geodetic Control

TO THE EDITOR: Those parts of Mr. Syme's paper, in the March issue, which refer to the local engineer or surveyor, were particularly interesting to me. The average surveyor and engineer can play a large part in helping to extend geodetic control and can, at the same time, derive much personal benefit from his efforts.

Too much emphasis cannot be placed upon Mr. Syme's statement that the survey which has been tied in to geodetic control is indestructible, as this is one of the main reasons for having geodetic control. Although every point of a survey may be lost or destroyed, the survey can be retraced and the old points relocated if the original survey has been tied in to a geodetic triangulation system. Some triangulation points may be lost, especially on coastal control, but they can be relocated, or a new control, fully as accurate as the original survey, can be established. The fact that the original survey can be thus accurately located is extremely important, particularly in title and court work.

That brings up the vital point of the importance of establishing the true meridian for surveys on which surveyors or engineers must give testimony in court. The magnetic meridian used by most surveyors is at the very best only approximate. This is due to local attractions, difference in the needles, and many other causes of error. Any case, involving two or more surveys, each with a different magnetic bearing, is often very confusing to the lawyers, jury, and even to the judge presiding over the case. When the various surveys can be brought into the true meridian and a given system of coordinates, the engineer not only has complete confidence in the accuracy of his work, but is also able to consolidate the various surveys and show clearly to the lawyers, jury, or judge the reasons for overlaps, discrepancies, and variations.

The establishing of the true meridian is also important from the title standpoint. Often the magnetic variations on title surveys are confusing to title searchers and officers. This is especially true when property has been surveyed two or three times within a period of years and each survey shows a magnetic bearing for each particular year. As a general rule, the question of the magnetic declination or variation is of less importance in cities than it is in country districts, because in the city the old lines are usually so connected with the street lines that their bearings are of minor importance.

On surveys where it is deemed advisable to establish base lines, and on coastal surveys, the establishment of geodetic control is extremely valuable. In prolonging base lines, the establishing of triangulation points is very important as it gives a close check on the measurement and alignment. On one project, it was necessary to establish a base line of about 11 miles, located approximately in the middle of a long and relatively narrow strip of beach and meadows as accurately as possible and at a minimum cost. The alignment was carefully run and checked with a new instrument, which was in perfect condition, and the distance was measured twice, with the proper allowance for temperature. The establishment of three U.S. Coast and Geodetic triangulation stations on this tract gave a very accurate check on the work.

Geodetic control is indispensable in sounding and dredging work, particularly for projects that are many miles long. The control points are not only permanently established, but the cost of the work is cut down, and the accuracy greatly increased. Usually the time element is very important, and here again geodetic control is a great help. Precise levels with permanent and easily accessible bench marks are of great value to engineers, particularly in flat country where it is extremely important to have precise levels based on an accurate control.

WALLACE H. HALSEY, M. Am. Soc. C.E.
Wallace H. Halsey, Inc.

Southampton, N.Y.
April 14, 1932

More Power Studies Needed

TO THE EDITOR: I should like to discuss the paper by Dr. Smith, in the March issue, along the two lines of fact finding and the exploitation of these facts.

In serving on the St. Lawrence Power Development Commission for the purpose of making a report on the possibility of marketing St. Lawrence power, and the price at which it could be marketed, Dr. John Bauer and I came in contact with the very intelligent members of this commission, none of whom were engineers. Immediately they asked us the question, "What is the reason for the difference or spread between the cost of generating power and the rates charged to the consumer?" Their impression was that a large part of this difference represents profit and that all overhead costs and profits are loaded on the poor domestic user. I believe that this opinion is now generally prevalent.

We therefore tried to discover what the relative costs of the various classes of service were in comparison with various rates charged, but found that detailed information in regard to the spread between generating costs and rates does not exist in published form. It is true that the power companies make studies and attempt to allocate costs to the various classes of service and use that information in connection with rate-making, but that information is not generally published. Another difficulty is that power is usually metered at the outgoing bus and again at the point of use, but there is no intermediate

record of the amount of power delivered to any definite community or class of service. Consequently we do not know what the relative transmission losses are for the various classes of service.

Another difficulty that arises in connection with allocation of costs is the joint use of facilities. When a power line is run through a community, industrial, commercial, and domestic power are often taken off the same line. We do not know accurately what proportion of the capital cost and operating cost should be charged to the various services, and any attempt to allocate these costs is a matter of judgment. It is also hard to determine the load factor of the various services which, of course, has a bearing upon the capital charges to be made against each class of service.

In one case, through the assistance of William Kelly, M. Am. Soc. C.E., former Chief Engineer of the Federal Power Commission and now vice-president of the Buffalo, Niagara, and Eastern Power Corporation, statistics were made available for the Buffalo District, and these were later published in the *Bulletin of the National Electric Light Association* for April 1931. This illuminating analysis showed a surprising agreement between the cost figures and the actual average rates charged for the various classes of service.

In spite of difficulties, such statistics should be collected, made public, and exploited. In no other way can the general public be made to realize why generating costs in mills per kilowatt hour often mean actual costs for domestic service in cents per kilowatt hour.

Even if these facts are obtained and put in shape for the public, there are at present no proper means of exploiting them. People will not listen without reservation to the trade associations or to the spokesmen for companies, because they believe their statements to be prejudiced.

There must be some way of bringing these facts to the attention of the public, but I doubt if an engineering society could do it. Some time ago a suggestion was made for the establishment of a regional power conference to be composed partly of the engineering or technical societies, partly of chambers of commerce, and partly of the electric light industry. Such an organization could issue information that the public would receive with confidence.

JOHN P. HOGAN, M. Am. Soc. C.E.
Parsons, Klapp, Brinckerhoff and Douglas

New York, N.Y.
May 2, 1932

Code for Small Municipality

DEAR SIR: In connection with the interesting article by Mr. Schwada in the March issue, I should like to outline the plan for the revision of street names and house numbers recently put into effect by the city of Upland, Calif. This plan, which is not yet complete in all details, is the result of diligent study by the Planning Commission. In some instances the Upland recommendations differ from those of Mr. Schwada. It should be borne in mind that the following outline is not in final form, but is offered as an addition to the fund of information presented by Mr. Schwada.

Two base lines shall be provided, paralleling the two most nearly perpendicular general directions of thoroughfares, and intersecting so as to divide the municipality into logical quadrants. These shall be designated as the north-south and east-west base lines, according to their general magnetic bearing. Where permanent barriers prohibit future extension of the city-limit lines, a base line may be located along such barriers.

Thoroughfares paralleling the east-west base line shall be known as "streets," and those paralleling the north-south base line, as "avenues." Diagonal, dead-end, and extremely short thoroughfares shall be given any of the following designations: road, court, place, drive, way, or plaza. Through arteries common to a series of communities shall be known as "highways" or "boulevards." To avoid confusion in the use of both numbered streets and numbered avenues, the former shall be used with the number preceding the term "street"; for example, "Eighth Street." The reversed form shall be used in connection with avenues, as "Avenue Eight."

All streets lying east of the north-south base line shall have prefixed to their respective names or designation, the term "east," so that each shall be known as "East ——Street," and similarly all such streets extending west of the north-south base line shall bear the prefix "west" and each shall be designated as "West—— Street."

Similarly, the prefixes for avenues lying north and south of the east-west base line shall be "north" and "south," respectively; for example "North Avenue——" or "South Avenue——." If one base line is coincident with a city-limits line, this prefix shall not be necessary for streets or avenues parallel to the other base line.

Avenues on one side of the north-south base line shall be numbered, progressing consecutively from the base line; avenues on the other side of the base line shall be lettered or named. The first letters are to be preferably in alphabetic sequence, progressing consecutively from the base line. Streets shall conform to the requirements given for avenues in this respect. Diagonal, dead-end, and extremely short thoroughfares shall bear named designations characteristic of their respective locations.

The use of names of near-by or well known cities or states is to be discouraged because of the possibility of confusion, especially with postal communications. Names established in near-by communities shall not be duplicated unless specific duplications are continuations of, or possible future extensions of, such thoroughfares. Names shall be euphonically perfect and shall have the quality of being easily spelled and easily pronounced.

Even numbers shall be used to designate locations on the southerly and easterly sides of streets and avenues, respectively. Odd numbers shall be assigned to the northerly and westerly sides.

For the purpose of simplicity it shall be assumed that the number assigned to a building is composed of "hundreds" and "decimals"; thus, the number 1650 shall be known as 16 (hundred) and 50 (decimal). So far as is reasonably possible, the "hundreds" digits of a block shall correspond with the number of that block counting from the base line, less one. (Thus, the "hundred" block between 16th Street and 17th Street shall be the "16.")

The "decimal" digits of a house number shall designate the approximate percentage of the distance between the house and the end of the block nearest its base line to the entire length of the block. Thus, a building in the middle of the 16-hundred block would be 1650 or 1651. It is intended that house numbers on opposite sides of a thoroughfare shall correspond as nearly as possible.

Dwellings on the rear of lots or holdings shall be given numbers allotted to the lot or holding, with the exception that there shall be added thereto the fraction $^1/_2$.

THEODORE C. COMBS, Jun. Am. Soc. C.E.
Building Inspector

Upland, Calif.
April 1, 1932

Street Naming System for the Borough of Queens, New York

To the Editor: The paper by Mr. Schwada, in the March issue, is a classic that no city planner can afford to ignore.

There is not much difficulty involved in laying out a system of numerical street names and house numbers, patterned after the so-called "Philadelphia system." The difficulty lies in carrying out this system. A city where the street system is almost entirely rectangular, as is 80 per cent of the Island of Manhattan, would be the simplest kind of a subject for the development of this system of house numbers. However, if an attempt were made to change the existing system of numbering in Manhattan to conform with the Philadelphia system, the task would be tremendous and almost impossible because of opposition from the inhabitants.

When we first began the planning and laying out of the Borough of Queens, New York City, there were about 60 villages, each one having its own street naming and house numbering system. There were about forty Washington streets and almost as many Lincoln, Fairview, and other streets. The area of the borough was five times that of Manhattan, the population only 250,000, and the assessed valuation about \$100,000,000, whereas today the population is over 1,000,000 and the assessed valuation has risen to over \$2,000,000,000.

Various schemes were suggested, such as independent systems for each ward or village which met with the wishes of the various neighborhoods, but would have caused great trouble to the borough in general. It was decided to use a coordinate system for street names and house numbers—that is, the street names, together with the house numbers, would act as an abscissa and ordinate, or as latitude and longitude, defining the geographical position of any particular house in the borough.

In 1911 a plan was devised for the borough, which made provision for numbered avenues running generally east and west and numbered streets running north and south, with First Avenue at the extreme north end of the borough and First Street at the extreme west adjacent to the East River. This plan is shown in Fig. 1.

Fig. 1. Key Map of Street Numbering System in Borough of Queens

Practically the entire population of the borough was opposed to the change. People were perfectly satisfied to have the system introduced everywhere except in their own particular locality. Consequently we had to defer the introduction of the numbering system wherever it was strongly opposed and begin operations in new areas that were just being developed. The purchasers of recently constructed buildings had no stationery printed, so they accepted the new house numbers and street names as a matter of course.

After a long period, the majority of the population was in favor of the numerical system, and a campaign of compulsion was begun. This resulted in raising the percentage of correctly numbered buildings to about 90 per cent. Another campaign will soon be started, which we hope will bring acceptance of the system near the 100 per cent mark.

It was feared that the high-numbered streets in the eastern section of the borough, made necessary by the numerical system, would result in large house numbers. For example, on an avenue crossed by 271st St., the house number would be 27,101—a difficult number to remember and an inconvenient one to use. This problem was solved by separating the last two figures from the first figures by a dash, making the number 271-01. Today this system has been voluntarily continued by property owners beyond the city limits, the numbers in outlying districts being higher of course than those that are within the city limits.

The obvious advantages of this system of numbering houses are that it indicates geographically the location of the house in the borough and that, even if there are no street signs erected in the territory, the house number will enable strangers to determine the number of the street they are about to cross. Queens has the distinction of being the only large city that is entirely covered by a system of mathematical street naming and house numbering.

Charles U. Powell, M. Am. Soc. C.E.
Engineer in Charge
Topographical Bureau, Borough of Queens

Long Island City, N.Y.
April 16, 1932

OLD FAITHFUL INN—CONVENTION HEADQUARTERS

Sixty-Second Annual Convention

Yellowstone National Park—July 6-9, 1932. Program of Sessions, Entertainments, and Trips

Opening Sessions—General Technical Meeting

WEDNESDAY—July 6, 1932—Morning

9:00 **Registration.**

10:00 **Sixty-Second Annual Convention** called to order by D. C. HENNY, *Vice-President, American Society of Civil Engineers; Consulting Engineer*, Portland, Ore.

10:05 **Address of Welcome.**

ELWOOD MEAD, *M. Am. Soc. C.E., Commissioner of Reclamation, Department of Interior*, Washington, D.C., representing the Hon. RAY LYMAN WILBUR, *Secretary of the Interior*.

Address of Welcome.

CLARENCE T. JOHNSTON, *M. Am. Soc. C.E., Professor of Geodesy and Surveying, University of Michigan*, Ann Arbor, Mich., representing His Excellency, A. M. CLARK, *Governor of the State of Wyoming*.

10:15 **Response.**

HERBERT S. CROCKER, *President, American Society of Civil Engineers; Consulting Engineer*, Denver, Colo.

10:30 **President's Annual Address.**

HERBERT S. CROCKER, *President, American Society of Civil Engineers*.

11:00 **The National Parks and Their Improvement.**

HORACE M. ALBRIGHT, *Esq., Director, National Park Service*, Washington, D.C.

11:40 **Discussion.**

12:30 **Business Meeting.**

12:45 **Luncheon.**

WEDNESDAY—July 6, 1932—Afternoon

Vice-President D. C. HENNY, *Presiding*

GENERAL TECHNICAL MEETING

2:00 **The Rise and Fall of the Public Domain.**

HERMAN STABLER, *M. Am. Soc. C.E., Chief, Conservation Branch, U.S. Geological Survey*, Washington, D.C.

2:40 **Discussion opened by**

R. K. TIFFANY, *M. Am. Soc. C.E., Consulting Engineer*, Olympia, Wash.

3:00 **Forests and Stream Flow.**

W. G. HOYT, *M. Am. Soc. C.E., Hydraulic Engineer (Principal), Conservation Branch, U.S. Geological Survey*, Washington, D.C., and H. C. TROXELL, *Assoc. M. Am. Soc. C.E., Assistant Hydraulic Engineer, Water Resources Branch, U.S. Geological Survey*, Los Angeles, Calif.

3:40 **Discussion opened by**

C. G. BATES, *Esq., Senior Sylviculturist, Lake States Forest Experiment Station, Department of Agriculture*, St. Paul, Minn.

DANIEL W. MEAD, *Hon. M. Am. Soc. C.E., Professor of Hydraulic and Sanitary Engineering, University of Wisconsin*, Madison, Wis.

WEDNESDAY—July 6, 1932—Evening

DINNER AND ENTERTAINMENT
OLD FAITHFUL INN

Following dinner, there will be an address by Dr. RICHARD M. FIELD, *Professor of Geology, Princeton University*, Princeton, N.J., on the **Geology of Yellowstone Park.**

Interesting Features Arranged for Pre-Convention Activities

SUNDAY, *July 3rd, Livingston, Montana, sight-seeing and attending Livingston Rodeo; afternoon, trip to Hunter's Hot Springs for the night.*

MONDAY, *July 4th, by train, Hunter's Hot Springs to Gardiner, thence by bus to Mammoth Hot Springs in Yellowstone Park, for luncheon and the night.*

TUESDAY, *July 5th, by bus after luncheon from Mammoth Hot Springs, via geyser basins, to Old Faithful Inn, the Convention Headquarters.*

HIGHWAY THROUGH GOLDEN GATE NEAR MAMMOTH HOT SPRINGS

Technical Divisions Hold Sessions All Day

THURSDAY—July 7, 1932—Morning

SESSIONS OF TECHNICAL DIVISIONS

HIGHWAY DIVISION—STRUCTURAL DIVISION

9:30 **Western Highway Bridge Practice.**

C. B. McCULLOUGH, *M. Am. Soc. C.E., Bridge Engineer, State Highway Department*, Salem, Ore.

Discussion.

10:30 **Roads in the National Parks.**

L. I. HEWES, *M. Am. Soc. C.E., Deputy Chief Engineer, U.S. Bureau of Public Roads*, San Francisco, Calif.

Discussion.

IRRIGATION DIVISION—POWER DIVISION

9:30 **The Development of the Columbia River.**

THOMAS M. ROBINS, *Esq., Colonel, Corps of Engineers, U.S.A., Division Engineer, Pacific Division, War Department*, San Francisco, Calif.

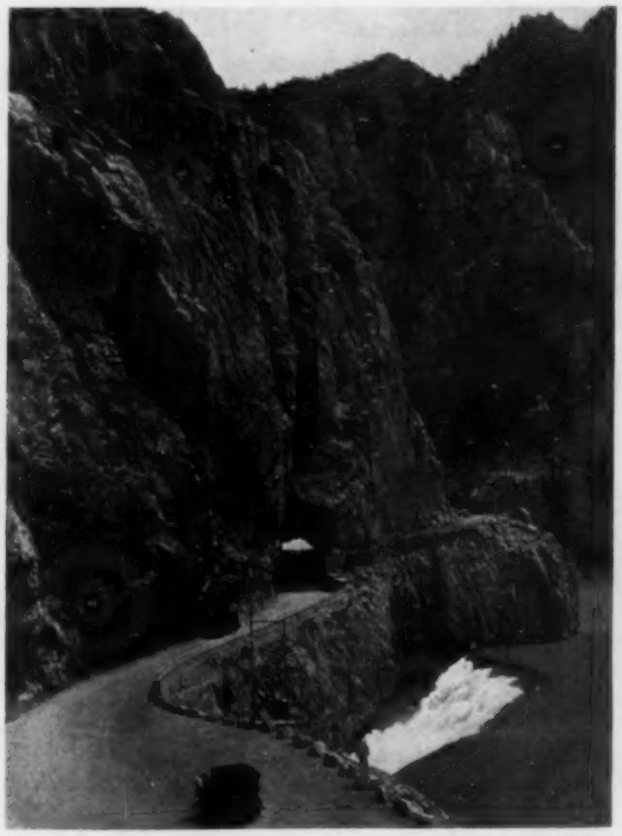
10:15 **Discussion.**

ROGER B. MCWHORTER, *M. Am. Soc. C.E., Chief Engineer, Federal Power Commission*, Washington, D.C.

HAROLD A. RANDS, *M. Am. Soc. C.E., Hydro-Electric Engineer, War Department*, Portland, Ore.

L. F. HARZA, *M. Am. Soc. C.E., Consulting Engineer; President, Harza Engineering Company*, Chicago, Ill.

SHOSHONE DAM AND POWER HOUSE



SHOSHONE SPILLWAY AND HIGHWAY

THURSDAY—July 7, 1932—Afternoon—SESSIONS OF TECHNICAL DIVISIONS

HIGHWAY DIVISION—STRUCTURAL DIVISION

2:00 **Steel Pile Foundations for Highway Bridges.**

J. G. MASON, *M. Am. Soc. C.E., Bridge Engineer, State of Nebraska*, Lincoln, Nebr., and ALFRED L. OGLE, *Assoc. M. Am. Soc. C.E., First Assistant Bridge Engineer, State of Nebraska*, Lincoln, Nebr.

Discussion opened by

WILLIAM GRANT, *M. Am. Soc. C.E., Consulting Engineer*, Lincoln, Nebr.

MILO S. FARWELL, *Structural Engineer, Pacific Coast Steel Corporation*, San Francisco, Calif.

3:00 **New Types of Reinforced Concrete Highway Bridges.**

J. W. BERETTA, *President, J. W. Beretta Engineers, Inc.*, San Antonio, Tex.

Discussion opened by

TERRELL BARTLETT, *M. Am. Soc. C.E., Consulting Engineer*, San Antonio, Tex.

IRRIGATION DIVISION—POWER DIVISION

1:30 **Effect of Uplift on Stability of Straight Gravity Dams.**

D. C. HENNY, *Vice-President, Am. Soc. C.E., Consulting Engineer*, Portland, Ore.

2:15 **Discussion opened by**

JOHN H. GREGORY, *M. Am. Soc. C.E., Consulting Engineer; Professor of Civil and Sanitary Engineering, The Johns Hopkins University*, Homewood, Baltimore, Md.

C. E. PEARCE, *Assoc. M. Am. Soc. C.E., Chief Designing Engineer, Pasadena Water Department*, Pasadena, Calif.

3:00 **Duty of Water in Terms of Canal Capacity.**

E. B. DEBLER, *M. Am. Soc. C.E., Hydraulic Engineer, U.S. Bureau of Reclamation*, Denver, Colo.

3:30 **Discussion opened by**

SAM G. PORTER, *M. Am. Soc. C.E., Manager, Department of Natural Resources, Canadian Pacific Railway*, Calgary, Alberta, Canada.

4:00 **Tests for Hydraulic Fill Dams.**

H. H. HATCH, *M. Am. Soc. C.E., Engineer in Charge, Cobble Mountain Reservoir, Springfield Water Works*, Westfield, Mass.

4:30 **Discussion.**

CONSTRUCTION DIVISION

2:00 **Construction Equipment of Hoover Dam.**

(Illustrated with Motion Pictures.)

NORMAN GALLISON, *Esq., Director of Public and Press Relations, Six Companies, Hoover Dam*, Las Vegas, Nev.

3:00 **Discussion.**

THURSDAY—July 7, 1932—Evening

7:00 **Dinner.**

Following dinner, the arrangements provide for dancing, visits to the museum and bear dens, or attending lectures, as desired.

TUNNELS ON LAKE SHORE DRIVE, SHOSHONE RESERVOIR

Entertainment for the Ladies

A meeting in the Yellowstone differs from most meetings in that no special features for the entertainment of the ladies during the time of the meetings on Wednesday and Thursday are necessary. Mother Nature provides lavishly for her guests, and Old Faithful Inn is a particularly good point from which to make excursions. Old Faithful itself performs with almost hourly regularity, and one can sit in a comfortable chair on the Inn porch and view this glorious spectacle.

Also, close by are other geysers which erupt with more or less frequency. Several of them, like the Jewel and the Sponge, spout at intervals varying from three minutes to ninety, so that one can be assured that patience will ultimately be rewarded. There is always a chance, too, that either the Giant or the Giantess may erupt during a stay at the Park. The Giant erupts at irregular intervals and then for one hour throws a column varying from 200 to 250 ft. in height.

Then there are notable springs and pools about which one may wander for hours, enjoying the constantly shifting colors and fantastic formations. There are such notable ones as Black Sand, the Chinaman, Emerald, Morning Glory, Punch Bowl, and Sunset Lake.

Delightful paths lead into the pine forests on every hand where one may see a variety of plant life. In fact, all spare moments may be easily occupied in constantly changing entertainment: short walking trips with guides; museums with lectures; and the ever-interesting evening event of feeding the bears.

BEARS ON HIGHWAY NEAR THUMB BAY, YELLOWSTONE LAKE

WATCHING THE GEYSERS FROM OLD FAITHFUL INN

Excursion and Geological Tour

FRIDAY—July 8, 1932—All Day

EXCURSION FROM OLD FAITHFUL TO CANYON

On Friday morning members and guests will bid goodbye to Old Faithful and travel by special buses to the Canyon Hotel, where they will spend the night.

This trip is one of ever-changing scenery and interest. Shortly after leaving Old Faithful, the road passes the famous Kepler Cascades and then rises to cross the Continental Divide through Craig Pass, where in springtime the waters of lily-covered Isa Lake flow to the Pacific and to the Atlantic. Seven miles further on, it crosses the Divide once more and leads down through dense timber to West Thumb. From the Thumb to the Lake Hotel there is a drive of twenty miles along the shore of Lake Yellowstone with its crystal-clear waters mirroring the great peaks which surround it. For those who prefer a trip upon those waters, there are speed boats that operate between the Thumb and the Lake Hotel at a nominal charge.

After leaving the Lake Hotel, the road continues north, past the entrance to the Cody Road, past the Mud Volcano and the awe-inspiring Dragon's Mouth, along the valley of the Yellowstone River to the turn in the road where the glittering whiteness of the Chittenden Bridge—named in honor of Gen. Hiram M. Chittenden, the engineer who did so much to open the Park to the general public—offers a pleasant crossing to Artist's Point, from which a magnificent view of the Great Falls of the Yellowstone may be obtained. The river, churned into a snow-white mass, drops 308 ft. into a canyon whose varied colors shift with every passing moment and utterly defy description. It is a tiring trip to the foot of the falls but the beauty lover is well repaid for his efforts. Returning across the Chittenden Bridge, the road leads past the Upper Falls (109 ft.) and to the Canyon Hotel, where the party will spend the night.

OLD FAITHFUL

SATURDAY AND SUNDAY

July 9 and 10, 1932

EXCURSION TO ROOSEVELT LODGE AND RETURN VIA CODY

For those interested, an instructive conclusion to the Convention has been arranged in a trip to Roosevelt Lodge on Saturday and to Cody on Sunday. The party will be conducted by Dr. Richard M. Field, Professor of Geology at Princeton University, who will point out and explain the many and unusual geological features.

The route to Roosevelt Lodge is northward from Canyon over Dunraven Pass and up to the summit of Mount Washburn (10,317 ft.), where a magnificent view is obtained down to lovely Tower Falls, which drop 132 ft. into an interesting gorge. Across the river a great columnar basaltic flow presents all the appearance of a stockade. Of the same columnar basalt is the famous Overhanging Cliff under which the road goes, past the Needle, a long slender spire which rises 300 ft. from the river's edge, and up to the hospitable shelter of Roosevelt Lodge. Near here is the petrified forest. The party will return to Canyon Hotel for the night.

EXCURSION TO CODY

Early Sunday morning the group will leave the Park by way of the Cody, or eastern, entrance.

From Canyon the route will be retraced as far as Lake Junction, and then the road to Cody, extending 90 miles to the east, will be followed. The trail ascends to Sylvan Pass (8,559 ft.), past beautiful Sylvan Lake, and then descends steeply to the eastern boundary of the Park. Continuing, the descent follows the north fork of the Shoshone River, which rushes down a canyon of wild and rugged beauty into the Shoshone National Forest. Gradually the valley broadens somewhat and the traveler has ample opportunity for seeing the fantastic shapes which wind and water have carved in the red volcanic rock which forms the sides of the valley. Many of these are named—The Duck, Elephant's Head, Chimney Rock, the Holy City—and are easily recognizable. Then across the ever-widening valley to Shoshone Lake, formed by the Shoshone Dam, and finally to the dam itself at the head of Shoshone Canyon. The dam is 328 ft. from the lowest foundation to the top of the parapet. Near the dam the canyon walls close in, high and precipitous, over the rushing stream, and frequently the road leads through tunnels cut through the granite. And then, after a ride which for sheer beauty and interest would be hard to duplicate, the visitor finds himself suddenly at the end of this high-walled canyon. Before him lies Cody, and beyond it, the wide-open country.

The Mighty Tetons, Jackson Hole

Terraces, Mammoth Hot Springs

Hotel Rates—Reduced Railroad Fares—Announcements

GRAND TETON PARK AND JACKSON HOLE COUNTRY

For those who are driving to the Convention or who have time to spare for a vacation either before or after the regular meetings, a trip—the more extended the better—through Grand Teton Park and the Jackson Hole country is recommended. Many beauty lovers feel that the proper way to approach the Park is through the southern entrance which is reached by way of Lander, Dubois, and over Twogwotee Pass, down into the Jackson Hole country at Moran. To come in this way and leave by the Cody entrance is to have seen the Park at its grandest and best. To cross Twogwotee Pass just as the sun is setting behind the Grand Tetons is to view a scene never to be forgotten. A number of lovely lakes, notably Leigh Lake and Jenny Lake, in addition to Jackson Lake, the largest, nestle at the foot of the Tetons. The fishing is excellent and trips into the mountains with pack trains are popular. There are dude ranches where one may stay and live the regular life of the cattle country. A list of these ranches is available for those who are interested.

About 70 miles south of the Park, in the Jackson Hole country, is Camp Davis, the surveying camp of the College of Engineering of the University of Michigan. Members who visit the Jackson Hole country are also invited to inspect Camp Davis.

Upper Falls and Chittenden Bridge

HOTEL RESERVATIONS

Adequate rooms to accommodate members and guests have been set aside at Hunter's Hot Springs, Mammoth Hotel, Old Faithful Inn, and Grand Canyon Hotel.

Members and others who do not go on the special Pre-Convention tour, may go directly to Old Faithful Inn for the Convention. They should notify the Inn of their plans and the space desired, well in advance of arrival.

HOTEL RATES IN PARK

All hotel and lodge rates are based on American plan

Hotel room, without bath, 2 or more persons, per person	$6.50
Hotel room, without bath, 1 person	7.00
Hotel rooms, with bath, are $2.00 to $3.00 per day extra, per person, according to location.	
Lodge rates, per person, per day	4.50

CAMPING THROUGH YELLOWSTONE

Many visitors prefer to go through Yellowstone Park the "camp way," that is, by sleeping in the lodges and eating at the pavilions. The accommodations are ample; the living is closer to nature and accordingly without formality and routine. As noted in the schedule, the rates are somewhat lower than in the hotels.

TRANSPORTATION IN PARK

Transportation for the tour of Yellowstone Park, regardless of the gateway used in entering or leaving the Park, will be $25, except that the side-trip fare from Canyon to Roosevelt Lodge and return to Canyon on Saturday will be $7 in addition per passenger. Tickets for Park transportation should be obtained from the home ticket agent at the same time rail transportation to Yellowstone Park is purchased. Variations from the official schedule are perfectly feasible, to accommodate those entering from West Yellowstone and others. Arrangements for such routing should, however, be made at the time tickets are purchased.

WEARING APPAREL

On account of the altitude in the Yellowstone and rapid changes in temperature that may occur, fall-weight clothing and medium-weight overcoats should be taken, and outing or sports wear is convenient.

SPECIAL CONVENTION TOUR

Plans have been made for the members of the Board of Direction, and others traveling from the east to meet those from the west at Livingston, Mont., on the morning of July 3.

After spending the day at the famous Livingston Rodeo, the group will go to Hunter's Hot Springs for dinner, lodging, and breakfast on the morning of July 4. Following breakfast, the group will travel by train and motor to Mammoth Hot Springs, arriving about noon. Here the Board of Direction will hold its meeting during the afternoon and evening of July 4 and in the forenoon of July 5.

There is a wealth of entertainment around Mammoth in the way of scenery, hikes, horseback riding, or fishing for those not occupied with the Board meetings.

After luncheon at Mammoth on July 5, the party will go by bus to Convention Headquarters at Old Faithful Inn, arriving there in time for dinner in the evening.

Professor Field expects to accompany the eastern delegation leaving Chicago on July 1, and if a sufficient number traveling together are going, a special car will be placed at the disposal of the group, equipped with geological maps and other information about interesting features along the route. This feature has so many advantages that it is hoped the advance reservations will warrant its inclusion.

Those participating in the trip to Roosevelt Lodge on Saturday, July 9, and returning via Cody on Sunday, July 10, may reach Chicago on Tuesday morning, July 12.

RAIL AND PULLMAN FARES

To Yellowstone Park from	Round-Trip Rail		Lower Berth Fares Round Trip		
	October 31st Limit	30-Day Limit	October 31st Limit	30-Day Limit	One Way
Boston, Mass.	$115.90	$ 90.58	$50.64	$42.00	$25.51
Chicago, Ill.	59.35	....	30.38	30.38	15.38
Dallas, Tex.	73.05	....	38.26	...	19.13
Denver, Colo.	39.90	....	16.50	...	8.25
Kansas City, Mo.	52.50	....	25.50	25.13	12.75
Los Angeles, Calif.	50.00*	....	25.50	...	12.75
Miami, Fla.	138.24	122.48	61.52	...	30.76
New Orleans, La.	97.10	....	51.02	42.00	25.51
New York, N. Y.	108.82	92.50	48.38	42.00	24.38
Philadelphia, Pa.	103.64	89.00	46.88	42.00	23.63
Pittsburgh, Pa.	83.51	75.07	39.38	39.38	19.88
Portland, Ore.	40.20†	....	21.00	...	10.50
Salt Lake City, Utah	15.10*	....	7.50	...	3.75
St. Louis, Mo.	61.95	....	31.51	29.25	16.88
St. Paul, Minn.	48.55	....	24.00	...	12.00
San Francisco, Calif.	50.00*	....	25.50	...	12.75
Seattle, Wash.	40.20†	....	21.00	...	10.50
Washington, D.C.	100.95	87.00	46.88	42.00	23.63

* To West Yellowstone and return.

† To Gardiner and return.

All other fares apply to Gardiner and return from Cody.

For those desiring to extend their trip on to the Pacific Coast, similar low rates are in effect.

RAILROAD RATES

Summer excursion rates, in effect at the time of the Convention, will reduce the cost of rail transportation. The accompanying table gives round-trip fares and Pullman rates to Yellowstone Park from various cities.

The program has been prepared by the Western Regional Meeting Committee, D. C. Henny, Vice-President Am. Soc. C.E., Chairman; E. B. Black, F. C. Herrmann, J. C. Stevens, Franklin Thomas, Directors Am. Soc. C.E. Reprints of this official program will be distributed at the Convention. Any member who wishes an advance copy should address the Secretary's office.

Please call on the members of the Western Regional Meeting Committee or on the Secretary's office for any service desired.

Members and others interested in joining the group that will assemble at Livingston on July 3 should instruct railroad agents to route tickets accordingly. Eastern members should request space in special cars set aside for the party to leave Chicago at 10:30 p.m. on July 1, via the Chicago, Burlington and Quincy Railway. Please notify the Secretary of the Society of your plans in order that those going on this trip may be known in advance.

TOWER FALLS

CHIMNEY ROCK ON CODY ROAD

SOCIETY AFFAIRS

Official and Semi-Official

Necessary and Productive Public Works

As the Most Effective Immediate Means of Stimulating Trade Recovery

ON May 9 the Executive Committee of the Society, after a canvass of the Board of Direction, considered a memorandum entitled "A Normal Program for Public Works Construction to Stimulate Trade Recovery and Revive Employment." This Program, after careful study, was approved in principle and the committee adopted a formal Resolution.

A special committee was appointed to assist in making the Program operative in fact. On May 19 President Crocker addressed a letter to President Hoover and this special committee presented that letter and the Program to the President in Washington. President Hoover replied, giving public release to his letter on May 23, and the same day a statement regarding it was issued by the special committee.

Opportunity is taken to present here in full the memorandum covering the Program, the Resolution of the Executive Committee, the ensuing correspondence and statement.

A Normal Program for Public Works Construction

To Stimulate Trade Recovery and Revive Employment

THE CHIEF ESSENTIAL of business recovery is the general resumption of trade. This implies the restoration of the consumer's will and capacity to buy, the result of which will be renewed buying by middlemen and manufacturers also.

At present all buying has been curtailed by: (1) loss of employment and reduced incomes, (2) fear and uncertainty as to the future, (3) declining commodity prices.

Remedies Already Applied

The remedies thus far applied by the federal government have been directed to: (1) greater security of financial institutions, (2) restoration of general confidence, (3) abatement of hoarding. The assumption underlying these measures has been that bank depositors would be reassured, and that hoarded funds would find their way into circulation, thereby securing banking assets, relieving the fears of bankers and increasing the volume of credit available to finance trade. With restored confidence and expanded credit would come a resumption of consumer and trade buying resulting in increased business and employment.

The immediate objectives of these efforts have been realized to an appreciable degree. General buying, however, still is backward. The ultimate and essential objective, therefore, has not yet been attained. The reason for this is not far to seek. The mentality of depression, generated during two years of declining volume and values, is still in command. So long as it prevails, dealers, both wholesale and retail, cannot be expected to replenish their stocks in the face of curtailed demand and falling prices; manufacturers and service utilities cannot be expected to speed up production or expand their production facilities in the face of excess capacity and depleted earnings. Trade languishes on a hand-to-mouth basis.

Thus every one has been caught in a vicious spiral of falling demand, declining output, increasing unemployment and diminishing consumer buying power. The improvement of financial security and general confidence has not as yet sufficed to overcome the momentum of the decline.

The Immediate Need

The immediate and urgent need, therefore, is somehow to prime the pump that maintains the flow of trade, to inject somewhere in the cycle an impulse that will check the decline and reverse its downward trend. Without this, the measures thus far taken to restore confidence fall short of their ultimate objective, which is the restoration of trade.

The most direct and immediate remedy, then, is to create a net consuming power that will make itself felt from the counters of dealers back to the shops of the manufacturers, developing increasing volume as it flows and breeding renewed confidence, which will become the basis of an even greater volume as the reversal of trend becomes evident and as commodity prices begin to rise.

The Part of Private Business

A certain amount of such consuming power has been generated by intelligent and aggressive merchandising policies in some branches of private enterprise. The present activity in the automotive field is a conspicuous example of this. Other fields are offering similar contributions. But large-scale recovery resulting from this process alone must be very slow, faltering and spotty. *The net effect* of the buying power that is created by increased employment in private industry is much smaller than might be assumed from the increase in wages and salaries paid, because of the inevitable increase in the volume of goods that are produced and must be absorbed by the consumer.

If it be possible to create a large consuming power without this proportionate increase in the current volume of goods to be bought, the necessary stimulus to trade can be applied more directly, more swiftly and with vastly increased net effect. The more swiftly and more heavily it can come into operation, the sooner will private enterprise feel its quickening influence and generate within itself the power to carry on the improvement.

Measures to Stimulate Buying

Several measures have been suggested whereby there may be applied such an impetus to consumer buying, but most of them are open to the serious objection that they are purely agencies of inflation, helpful if scrupulously controlled, but dangerously likely to get out of hand and make matters worse.

Federal Credit for Productive Public Works

***Resolved,* That the American Society of Civil Engineers, through its Executive Committee,**

1. Approves in principle a normal program of public works construction as the most effective immediate means of increasing purchasing power stimulating trade recovery and reviving employment; and

2. Urges on the Congress of the United States the enactment of the necessary legislation to extend Federal credit facilities to solvent states, counties and municipalities to enable them to carry out their normal programs of necessary and productive public works.

One recourse is available, however, that offers the brightest promise of an immediate stimulation of consuming power without a counter-balancing production of goods for current consumption. It would avoid the demoralization of a dole, conserve the wealth represented by the funds released and avert the peril of excessive inflation. These requisites all can be met by a nation-wide program of public works construction—federal, state, county and municipal—the state, county and municipal works to be financed by bond issues reinforced for the period of the emergency by the credit of the federal government, in order to insure reasonable interest rates.

An expansion of public works construction is particularly necessary and appropriate just at this time because of the substantial decline in construction volume that has already taken place and that is in sight for the immediate future. In 1926 the total volume of construction, both public and private, was nearly \$9,000,000,000. Disregarding the peak developed during 1927, 1928 and 1929, this volume in 1930 was less than \$8,000,000,000 and in 1931 it had fallen to \$6,000,000,000. Estimates for 1932, based upon the record to date and the present outlook, aggregate less than \$3,000,000,000 of construction work, or only half that of last year and appreciably less than that of 1919 and 1920.

It is noteworthy that for the past six years the volume of public works construction alone has remained reasonably constant at about \$3,000,000,000, despite the peak in private work, indicating that this figure represents the normal and reasonable requirement for community facilities.

Slight hope remains for any considerable volume of private and industrial construction during 1932. Public work, therefore, constitutes the only reliance for construction activity, and present estimates indicate that this will amount to scarcely more than \$1,500,000,000 or about half the normal. Surveys made by the President's Organization on Unemployment Relief indicate that the amount of necessary and worthy projects *abandoned* during the past twelve months would be enough to restore the program to normal.

A Public Works Construction Program

A Public Works Construction Program offers several advantages that deserve serious consideration.

1. The funds expended to pay for such works add directly to the buying power of the community without a counterbalancing production of goods that must be bought out of current income.
2. Public works add to the public wealth in the form of community facilities and thereby conserve the wealth represented by the funds thus released.
3. Such a program starts a train of increased employment that reaches back through many industries in many communities, thereby stimulating activity of private industry.
4. It uses existing public works organizations, thereby saving valuable time in getting under way, while avoiding wide-spread additional unemployment now threatened by the further suspension of public works and restoring to useful and productive work many now unemployed.

It may be urged against such a program that eventually the taxpayer must pay, in the form of interest and sinking fund charges, for the facilities thus provided. That is true, but meanwhile the impetus to buying will have made itself so felt in trade that the taxes, when due, will bear less heavily upon restored incomes. Furthermore, such taxes represent an investment in community facilities; they do not involve the sheer waste and demoralization of a dole.

Public Works vs. Direct Relief

Taxes to pay doles or direct relief under any other name contribute little to the stimulation of trade and are far more burdensome to the taxpayer, especially as they must be raised at a time when he is least able to pay them.

To illustrate the economy of unemployment relief by stimulating trade rather than by taxation to pay a dole, assume a public works construction program amounting to \$3,000,000,000. This involves a charge for interest and amortization of about \$150,000,000 per year. It is estimated that such a program would give employment to between 1,500,000 and 2,000,000 workers per year, distributed through the several industries that serve construction and widely scattered over the country. To support these same workers in idleness would cost the community between \$750,000,000 and \$1,000,000,000 per year. This sum must be raised through taxation or bond issues. But the money so raised would be wasted, the moral effect of a premium on idleness would be unfortunate, little if any stimulus would be given to normal trade and the current burden upon the depleted earning power of the community would be greatly multiplied. If the community is to shoulder the burden of maintaining its less fortunate members, is it not wiser and more reasonable to utilize their productive capacity in adding to the community wealth and thereby stimulate the normal processes of trade upon which must depend the restoration of community prosperity?

Taxes and Budgets

So much emphasis has recently been laid upon the subject of taxes that the public is prone to lose its sense of proportion. It forgets that any additional taxes required to finance a program as here proposed will be negligible as compared with the shrinkage of values and loss of earnings that prevail under present conditions. They will be equally negligible when paid out of the earnings of a revived trade and industry.

It is certain that the very initiation of such a program will have an effect upon the public mind and generate a revival of confidence that will stimulate trade beyond the amount of the funds actually released to carry on the public works.

It may be urged that such a program is contrary to the present demand for a general balancing of governmental budgets. But it must be remembered that the balancing of budgets on paper is one matter; actual balancing is quite another. That must depend upon the collection of the estimated revenues, which, in turn, must depend upon maintaining the earnings of the community, the ultimate source of all taxes. Budgets cannot be balanced *in fact* by methods that strike down the earning power of those who must provide the revenues.

Furthermore, the balancing of budgets so far as *current operations* are concerned is desirable; but it is not necessary to include in such balancing the principal sums invested in useful public works. Competent economic opinion has almost universally held that it is wise governmental finance to borrow for this purpose in periods of depression and to repay out of taxes leeied upon the surplus earnings of prosperity. Public works built at present wage and price levels and financed at reasonable rates of interest will carry a very low cost and require a relatively lower debt-service charge in the tax-rate over years to come. *It is good business as well as good tactics to use this opportunity to add substantially to the public wealth.*

State and Municipal Programs Essential

Federal public works alone, however expanded, cannot possibly meet the requirements of the situation. The major effort must be exerted through the state, county and municipal programs, which normally provide the bulk of our public works construction. But it is the municipalities and some of the states which have found great difficulty during recent months in raising sufficient funds at reasonable interest rates to finance their 1932 programs; and this is despite an urgent need for many such works, for which plans are already prepared and construction organizations in existence.

It is proposed, therefore, that the federal government maintain the largest feasible federal public works program and that it reinforce the credit of states, counties and municipalities sufficiently to enable them to carry out their necessary public works programs through their own bond issues. This might be accomplished either by a federal bond issue, the proceeds of which would be loaned to the several states or municipalities, or, preferably, by the establishment of a credit agency similar in principle and operation to those already set up for the extension of federal credit to financial institutions and corporations.

Proposed Legislation

In attempting to formulate specific legislation to this end it is necessary to keep in mind not only the objective sought but also the administrative and political difficulties involved. These arise from the constant changes in the economic and financial situation and outlook.

The following proposals for legislation can only establish a

basis upon which may be developed any alternative measure that may meet the essential requirements, and may be in accord with the current public attitude toward economic legislation.

The legislation necessary to effect the purpose proposed could be based upon that which has already found successful application in the Reconstruction Finance Corporation, i. e., the credit of the federal government could be extended to *reinforce* the securities of states, counties and municipalities that may be issued to finance necessary and useful public works. It is possible that this function might be assigned directly to the Reconstruction Finance Corporation or to some affiliated agency. If this be not feasible, an independent but analogous agency should be set up for this purpose.

It is true that when the Reconstruction Finance Corporation was established such a policy was rejected, but since that time the Corporation has demonstrated its capacity to function successfully, conditions and needs have changed, and it may now be in order to extend its operations beyond the scope to which it was then thought wise to limit them.

Moreover, it has become evident that the most promising sphere in which to seek an early and effective expansion of trade is that of public works construction. If federal credit is to be invoked for the purpose of stimulating trade, the time has come, therefore, to apply it where it has the most promising opportunity to accomplish the largest measure of results in the shortest time.

No present recommendation is made here as to the floating of a federal bond issue, but the possibility of such a measure must be kept constantly in mind as a preferable alternative to federal borrowing for a dole or for any other form of direct relief. If the government must borrow to effect economic relief, it will be far better to invest the funds so raised in community facilities, thereby conserving the public wealth and stimulating a normal resumption of trade than to disperse them in wasteful, inflationary or demoralizing expenditure.

In operation, a federal credit corporation as here proposed would examine and pass on state, county and municipal projects for which money cannot now be raised. If these projects were found to be economically sound, properly planned and administered, it would purchase the necessary bonds or other approved obligations of the states or municipalities at reasonable interest rates, and would hold them until such time as they could be sold in the public market without loss. The federal government thus would be eventually reimbursed, the cost of improvements assessed on the beneficiaries and supervision would be provided to curb wasteful expenditure.

It is indeed possible that no large amount of capital would be permanently employed. The guarantee of this finance corporation that the works were justified and sound and that the municipality or state was in good financial condition would be sufficient to make the securities marketable after a short period. It is possible also that the difference between the interest rates charged to the borrowers, and those that would be paid on the obligations of the corporation, would be sufficient to defray the expense of administration, and that the net ultimate cost of the whole operation to the federal government would be nil.

Character of Work to Be Done

Under the heading "Contemplated Projects as Reported to the Public Works Section, President's Organization on Unemployment Relief," a circular is sent out almost daily, to cooperating organizations, listing reports of new public works projects of states, counties and municipalities as reported to the President's Organization. The following statement appears at the head of each circular.

"This listing of contemplated projects may assist you in promoting the construction of necessary public work in your territory. . . ."

An analysis of these reports and their summaries shows that \$1,963,000,000 worth of state, county and municipal construction contemplated for 1931 has not gone forward, and reports of new projects for 1932 indicate that the total of these for the year approaches \$1,000,000,000. Combining these two figures it would appear that the necessary public works which are ready to go forward during 1932 amount to at least \$3,000,000,000.

The work listed by the President's Organization includes betterments and additions to municipal utilities such as water works, sewers, transportation and power systems, bridges and tunnels, roads and street paving, sewerage and sewage disposal, grade separation and grade crossing elimination, dock and waterway construction. The list also includes municipal, county and state buildings, parks and recreational facilities, airports, schools, hospitals, churches, etc.

In addition to the statistical work undertaken by the President's Organization on Unemployment Relief, other statistics are being compiled by the Federal Employment Stabilization Board, the Bureau of Labor Statistics, the National Conference on Construction, and other organizations.

The data which are being collected by these organizations form the basis of the conclusion that programs of necessary public works are being abandoned at such a rapid rate that less than one third of a normal year's program will go forward in 1932, allowing an accumulation of at least \$3,000,000,000 worth of necessary public works awaiting action which would permit them to be placed under construction.

Conclusion

Steps should be taken at once, therefore, to embody a program of Public Works Construction in appropriate legislation, either as an amendment to existing law, as a new bill, or as a provision of some appropriate bill now under the consideration of Congress. There is urgent need for the trade stimulus that can be realized through a public works program, soundly planned and adequately safeguarded as here proposed. The guarantee of federal credit has been a healthy influence in restoring the security and stability of the financial structure; now is the opportunity to apply it to the actual stimulation of business recovery.

Public Works Construction Program

Resolution Adopted by Executive Committee, May 9, 1932

Whereas, All buying has been curtailed by the loss of employment and reduced incomes, fear and uncertainty as to the future, and declining commodity prices; and

Whereas, Present trends indicate that trade will decrease and unemployment will increase until a more nearly normal purchasing power has been created; and

Whereas, It will be more difficult to relieve unemployment during the next year than was practicable during the past winter through relief funds obtained from public and private agencies; and

Whereas, A large amount of planned, productive, and necessary public works construction is now held in abeyance due to present difficulties in its financing; which if financed would aid in increasing trade and relieving unemployment; and

Whereas, The construction of worthy public works could be expedited by extending Federal credit facilities, under proper safeguards, to solvent states, counties, and municipalities; and

Whereas, It is more economical and advantageous for the nation, and its subdivisions, to meet current capital carrying charges on expenditures for productive public works, than to provide for extensive, non-productive, and demoralizing doles; and

Whereas, There has been drafted a memorandum entitled, "A Normal Program for Public Works Construction to Stimulate Trade Recovery and Revive Employment," which sets forth the principle that through such a program the restoration of normal purchasing power can be made promptly effective; therefore be it

Resolved, That the American Society of Civil Engineers, through its Executive Committee,

1. Approves in principle a normal program of public works construction as the most effective immediate means of increasing purchasing power, stimulating trade recovery, and reviving employment; and

2. Urges on the Congress of the United States the enactment of the necessary legislation to extend Federal credit facilities to solvent states, counties, and municipalities to enable them to carry out their normal programs of necessary and productive public works.

President Hoover Addressed by President Crocker

New York City
May 19, 1932

Honorable Herbert Hoover
President of the United States
The White House
Washington, D. C.

My dear Mr. President:

The American Society of Civil Engineers has given extensive consideration to the further expansion of federal, state and municipal constructive work as an aid to unemployment and business. We have been in favor of such reasonable expansion under proper safeguards. We have, however, read with very great interest your recent plan for relief of unemployment, in which you set up a new and important distinction between such works at large on one hand and income producing projects on the other as a sound basis of procedure. And you made a short statement as to the respective effects of the two plans as they related to the burdens upon the taxpayer and the balancing of the budget.

The American Society of Civil Engineers is interested in forwarding every sane effort. It would be of great assistance to us if you could amplify the question in its various bearings. Our purpose in making this request is that through the great corps of engineers who are members of this and other organizations of American Engineering Council, we could possibly be of assistance in the situation by voluntary preliminary surveys of possible sound projects.

Respectfully yours,

HERBERT S. CROCKER
President, American Society of Civil Engineers

President Hoover Replies

The White House
Washington

May 21, 1932

Mr. Herbert S. Crocker, President,
American Society of Civil Engineers,
New York, New York.

My Dear Mr. Crocker:

I am in receipt of your kind letter of May 19th, and I have also the presentation of the sub-committee of the Society suggesting that the depression can be broken by a large issue of federal government bonds to finance a new program of huge expansion of "public works" construction, in addition to the already large programs now provided for in the current budgets. The same proposals have been made from other quarters and have been given serious consideration during the past few days.

The back of the depression cannot be broken by any single government undertaking. That can only be done with the cooperation of business, banking, industry, and agriculture in conjunction with the government. The aid the government may give includes: (*a*) The quick, honest balancing of the Federal budget through drastic reduction of less necessary expenses and the minimum increase in taxes; (*b*) The avoidance of issue of further Treasury securities as the very keystone of national and international confidence upon which all employment rests; (*c*) The continuation of the work of the Reconstruction Corporation which has overcome the financial strain on thousands of small banks, releasing credit to their communities, the strengthening of building and loan associations, the furnishing of credit to agriculture, the protection of trustee institutions and the support of financial stability of the railways; (*d*) The expansion of credit by the Federal Reserve Banks; (*e*) The organized translation of these credits into actualities for business and public bodies; (*f*) Unceasing effort at sound strengthening of the foundations of agriculture; (*g*) The continuation of such public works in aid to unemployment as does not place a strain on the taxpayer and do not necessitate government borrowing; (*h*) continuation of national, community and individual efforts in relief of distress; (*i*) The introduction of the five day week in government which would save the discharge of 100,000 employees and would add 30,000 to the present list; (*j*) The passage of the Home Loan Discount Bank legislation which would protect home owners from foreclosure and would furnish millions of dollars of employment in home improvement without cost to the Treasury; (*k*) Financial aid by means of loans from the Reconstruction Corporation to such states as, due to the long strain, are unable to continue to finance distress relief; (*l*) The extension of the authority of the Reconstruction Corporation not only in a particular I called attention to last December,—that is, loans on sound security to industry where they would sustain and expand employment,—but also in view of the further contraction of credit to increase its authority to expand the issue of its own securities up to $3,000,000,000 for the purpose of organized aid to "income producing" works throughout the nation, both of public and private character.

1. The vice in that segment of the proposals made by your society and others for further expansion of "public works" is that they include public works of remote usefulness; they impose unbearable burdens upon the taxpayer; they unbalance the budget and demoralize government credit. A larger and far more effective relief to unemployment at this stage can be secured by increased aid to "income-producing works." I wish to emphasize this distinction between what for purposes of this discussion we may term "income producing works" (also referred to as "self-liquidating works") on the one hand and non-productive "public works" on the other. By "income-producing works" I mean such projects of states, counties and other sub-division as waterworks, toll-bridges, toll tunnels, docks and any other such activities which charge for their service and whose earning capacity provides a return upon the investment. With the return of normal times, the bonds of such official bodies based upon such projects can be disposed of to the investing public and thus make the intervention of the Reconstruction Corporation purely an emergency activity. I include in this class aid to established industry where it would sustain and increase employment with the safeguard that loans for these purposes should be made on sound security and the proprietors of such industries should provide a portion of the capital. Non-productive "public works" in the sense of the term here used include public buildings, highways, streets, river and harbor improvement, military and navy construction, etc., which bring no direct income and comparatively little relief to unemployment.

2. I can perhaps make this distinction clear by citing the example of the recent action of the Reconstruction Finance Corporation in the matter of the Pennsylvania Railroad Company on one hand, and the recent bill passed by the House of Representatives for increased road building on the other. The railroad company applied to the Reconstruction Corporation for a loan of $55,000,000 to help finance a fund of over $68,000,000 needed to electrify certain of its lines. By so doing it would employ directly and indirectly for one year more than 28,000 men distributed over twenty different states. An arrangement was concluded by which the Reconstruction Corporation undertook to stand behind the plan to the extent of $27,000,000, the railway company finding the balance. This $27,000,000 is to be loaned on sound securities and will be returned, capital and interest, to the Corporation. The Reconstruction Corporation is acting as agent to make available otherwise timid capital for the Pennsylvania Railroad in providing employment. There is no charge upon the taxpayer. On the other hand, the proposal of the House of Representatives is to spend $132,000,000 for subsidies to the states for construction of highways. This would be a direct charge on the taxpayer. The total number of men to be directly employed is estimated at 35,000 and indirectly 20,000 more. In other words, by this action we would give employment to only 55,000 men at the expense by the government of $132,000,000, which will never be recovered. In the one instance we recover the money advanced through the Reconstruction Corporation, we issue no government bonds, we have no charge on the taxpayer. In the other instance, we have not only a direct cost to the taxpayer but also a continuing maintenance charge, and furthermore, the highways in many sections have now been expanded beyond immediate public need.

3. These proposals of huge expansion of "public works" have a vital relation to balancing the federal budget and to the stability of national credit. The financing of "income-producing works" by the Reconstruction Corporation is an investment operation, requires no congressional appropriation, does not unbalance the budget, is not a drain upon the Treasury, does not involve the direct issue of government bonds, does not involve added burdens upon the taxpayer either now or in the future. It is an emergency operation which will liquidate itself with the return of the investor to the money markets.

The proposal to build non-productive "public works" of the category I have described necessitates making increased appropriations by the Congress. These appropriations must be financed by immediate increased taxation or by the issuance of government bonds. Whatever the method employed, they are inescapably a burden upon the taxpayer. If such a course is adopted beyond the amounts already provided in the budget now before Congress for the next fiscal year, it will upset all possibility of balancing the budget; it will destroy confidence in government securities and make for the instability of the government which in result will deprive more people of employment than will be gained.

4. I have for many years advocated the speeding up of public works in times of depression as an aid to business and unemployment. That has been done upon a huge scale and is proceeding at as great a pace as fiscal stability will warrant. All branches of government,—Federal, state and municipal,—have greatly expanded their "public works" and have now reached a stage where they have anticipated the need for many such works for a long time to come. Therefore, the new projects which might be undertaken are of even more remote usefulness. From January, 1930, to July 1st, 1932, the Federal Government will have expended $1,500,000,000 on "public works." The budget for the next fiscal year carries a further $575,000,000 of such expenditures (compared with about $250,000,000 normal) and includes all the items I have felt are justified by sound engineering and sound finance. Thus by the end of next year the Federal Government will have expended over $2,000,000,000 on public works, which represents an increase over normal of perhaps $1,200,000,000. Thus we have largely anticipated the future and have rendered further expansion beyond our present program of very remote usefulness and certainly not justified for some time to come, even were there no fiscal difficulties. They represent building of a community beyond its necessities. We cannot thus squander ourselves into prosperity.

5. A still further and overriding reason for not undertaking such programs of further expansions of Federal "public works" is evident if we examine the individual projects which might be undertaken from an engineering and economic point of view. The Federal "public works" now authorized by law cover works which it was intended to construct over a long term of years and embrace several projects which were not of immediate public usefulness. In any event, the total of such authorized projects still incomplete on the 1st of July will amount to perhaps $1,300,000,000. If we deduct from this at once the budgeted program for the next fiscal year—$575,000,000—we leave roughly $725,000,000 of such authorized works which would be open for action. If we examine these projects in detail, we find great deductions must be made from this sum. Construction of many projects physically requires years for completion such as naval vessels, buildings, canalization of rivers, etc. and, therefore, as an engineering necessity this sum could only be expended over four or five years; a portion of the projects not already started will require legal and technical preparation and therefore could not be brought to the point of employment of labor during the next year; a portion of these authorized projects are outside continental United States and do not contribute to the solution of our problem; a portion are in the District of Columbia where we already have a large increase in program for the next fiscal year and where no additional work could be justified. A portion are of remote utility and are not justified, such as extension of agricultural acreage at the present time. Deducting all these cases from the actual list of authorized Federal public works, it will be found that there is less than $100,000,000 (and this is doubtful) which could be expended during the next fiscal year beyond the program in the budget. That means the employment of say less than 40,000 men. Thus the whole of these grandiose contentions of possible expansion of Federal "public works" fall absolutely to the ground for these reasons if there were no other.

If it is contemplated that we legislate more authorizations of new and unconsidered projects by Congress we shall find ourselves confronted by a log-rolling process which will include dredging of mud creeks, building of unwarranted post-offices, unprofitable irrigation projects, duplicate highways and a score of other unjustifiable activities.

6. There is still another phase of this matter to which I would like to call attention. Employment in "public works" is largely transitory. It does not have a follow-up of continued employment as is the case with "income-producing works." But of even more importance than this, the program I have proposed gives people employment in all parts of the country in their normal jobs under normal conditions at the normal place of abode, tends to reestablish normal processes in business and industry and will do so on a much larger scale than the projects proposed in the so-called "public works" program.

7. To sum up. It is generally agreed that the balancing of the Federal budget and unimpaired national credit is indispensable to the restoration of confidence and to the very start of economic recovery. The Administration and Congress have pledged themselves to this end. A "public works" program such as is suggested by your committee and by others, through the issuance of Federal bonds creates at once an enormous further deficit.

What is needed is the return of confidence and a capital market through which credit will flow in the thousand rills with its result of employment and increased prices. That confidence will be only destroyed by action in these directions. These channels will continue clogged by fears if we continue attempts to issue large amounts of government bonds for purposes of non-productive works.

Such a program as these huge Federal loans for "public works" is a fearful price to pay in putting a few thousand men temporarily at work and dismissing many more thousands of others from their present employment. There is vivid proof of this since these proposals of public works financed by Government bonds were seriously advanced a few days ago. Since then United States Government bonds have shown marked weakness, on the mere threat. And it is followed at once by a curtailment of the ability of states, municipalities and industry to issue bonds and thus a curtailment of activities which translate themselves into decreased employment.

It will serve no good purpose and will fool no one to try to cover appearances by resorting to a so-called "extraordinary budget." That device is well known. It brought the governments of certain foreign countries to the brink of financial disaster. It means a breach of faith to holders of all Government securities, an unsound financial program and a severe blow to returning confidence and further contraction of economic activities in the country.

What you want and what I want is to restore normal employment. I am confident that if the program I have proposed to the Congress is expeditiously completed and we have the cooperation of the whole community, we will attain the objective for which we have been searching so long.

Yours faithfully,

Herbert Hoover

Special Committee's Statement

On May 23, following the publication of President Hoover's letter, the Special Committee made the following statement.

The Committee is in complete accord with the President in the necessity of a quick, honest balancing of the Federal Budget, and the provisions for the extension of credit relief. There are, however, in the President's discussion several statements attributed to the Society which must have originated from some other source.

Referring to the first paragraph of the President's letter, the American Society of Civil Engineers did not suggest "that the depression can be broken by a large issue of Federal government bonds to finance a new program of huge expansion of public works construction." While the Society in its Program discussed various methods of financing, it declared its preference for the following method as quoted from the memorandum presented to the President:

"The legislation necessary to effect the purpose proposed could be based upon that which has already found successful application in the Reconstruction Finance Corporation, i. e., the credit of the federal government could be extended to *reinforce* the securities of states, counties, and municipalities that may be issued to finance necessary and useful public works. It is possible that this function might be assigned directly to the Reconstruction Finance Corporation or to some affiliated agency. If this be not feasible, an independent but analogous agency should be set up for this purpose."

"In operation, a federal credit corporation as here proposed would examine and pass on state, county, and municipal projects for which money cannot now be raised. If these projects were found to be economically sound, properly planned and administered, it would purchase the necessary bonds or other approved obligations of the states or municipalities at reasonable interest rates, and would hold them until such time as they could be sold in the public market without loss. The federal government thus would be eventually reimbursed, the cost of improvements assessed on the beneficiaries, and supervision would be provided to curb wasteful expenditure."

The American Society of Civil Engineers did not advocate a huge increase in the *Federal* Program of public works but made the following statement in its memorandum:

"Federal public works alone, however expanded, cannot possibly meet the requirements of the situation. The major effort must be exerted through the state, county, and municipal programs, which normally provide the bulk of our public works construction. But it is the municipalities and some of the states which have found great difficulty during recent months in raising sufficient funds at reasonable interest rates to finance their 1932 programs; and this is despite an urgent need for many such works, for which plans are already prepared and construction organizations in existence."

While Federal public works have been expanded during the current depression; state, county, and municipal public works for which the normal expenditures during the past eight years were $2,500,000,000 will not exceed $800,000,000 for the current year, on account of the difficulty experienced by these latter subdivisions in obtaining money at reasonable rates of interest. The net effect of this decrease will be that over a million additional people will be thrown out of work during the present year on the work itself and in the industries furnishing materials.

The Committee is at a loss to know what is meant by the first sentence under topic one of the President's letter, which states that "the proposals made by your Society and others for further expansion of public work include public works of remote usefulness." The Society submitted no list of projects but urged "the enactment of the necessary legislation to extend Federal credit facilities to solvent states, counties, and municipalities to enable them to carry out their programs of necessary and productive public works." The Society in its memorandum thus emphasized the point made by the President that any works undertaken by the states, counties, or municipalities should be of a productive or self-sustaining nature. Many types of public works not ordinarily self-sustaining from the point of view of revenue, can be made so by allocating a sufficient portion of the revenues created by such projects to the service charges and amortization of the securities issued against them. Thus, in the states of Missouri and North Carolina, a portion of the gasoline taxes has been definitely allocated to the service charges and amortization of the bonds issued against roads.

It is the universal experience after a depression that the first revival in building is in construction of cheap housing either in individual dwellings or in low-priced apartments. The initiation of this work is universally recommended, both in the President's program and all of the various programs or bills which have been submitted to date. Such programs cannot go forward unless financing is provided for the necessary municipal improvements, such as water supply, sewerage, and street paving. Normally this work is done through special assessments repaid by the property owner. Special assessments of this character should be included in any program of federal credit since it encourages private work several times the amount of municipal improvements and unless municipal work of this character is permitted to go forward, it will be very difficult to finance the housing projects.

The Committee reiterates the concluding statement of the memorandum of the American Society of Civil Engineers. "Steps should be taken at once, therefore, to embody a program of Public Works Construction in appropriate legislation, either as an amendment to existing law, as a new bill, or as a provision of some appropriate bill now under the consideration of Congress. There is urgent need for the trade stimulus that can be realized through a public works program, soundly planned and adequately safeguarded as here proposed. The guarantee of federal credit has been a healthy influence in restoring the security and stability of the financial structure; now is the opportunity to apply it to the actual stimulation of business recovery."

JOHN P. HOGAN, *Chairman*.

Secretary's Abstract of Executive Committee Meeting, May 9, 1932

The Executive Committee met on May 9, 1932, at Society Headquarters. Present were President Herbert S. Crocker in the Chair; George T. Seabury, Secretary; Otis E. Hovey, Treasurer; and Messrs. Chester, Coleman, Mead, Stuart, and Tuttle.

Engineers' National Relief Fund

A report was received from the committee administering the Engineers' National Relief Fund, outlining its activities, procedure, and results in the affording of relief to unemployed engineers outside the areas of influence of the local sections. An abstract of its report appears elsewhere in this section.

Certification Into the Profession

A report was received from the joint committee composed of appointees from the four Founder Societies, the American Institute of Chemical Engineers, The Society for the Promotion of Engineering Education, and the National Council of State Boards of Engineering Examiners. The report outlined and recommended adoption of a procedure looking toward the certification into the profession of the younger men, as they progress in their post-scholastic education and in their practical experience, to the attainment of qualifications which may be adopted as the minimum requirements for recognition as warranting "certification into the profession." The report was referred to the Board of Direction.

Designation of Professional Specialties

A report was received from the Committee on Registration of Engineers on the subject of the designations now applied to, or adopted by, the members of the profession as indicative of their specialties. This also was referred to the Board of Direction with recommendation of adoption.

Alfred Noble Prize

Certain minor changes in the rules governing the award of the Alfred Noble Prize were approved. These changes are of such nature as to affect the committee's procedure rather than the significance of the award.

American Standards Association

Certain abbreviations for scientific and engineering terms, as submitted by the American Standards Association, were approved.

Standard Letter-Heads

Standard letter-heads for Local Sections, Student Chapters, Technical Divisions, and Special Committees were adopted. The new letter-head will bear the badge of the Society, the name of the Society, and the name of the Society unit, all centered, the object being, incidentally, reduction in expense, but more particularly, simplification and uniformity of character.

Public Works Construction Program

The committee received a communication signed by several members of the Society, transmitting a memorandum entitled "A Normal Program for Public Works Construction to Stimulate Trade Recovery and Revive Employment," which, after careful study in detail, was adopted by resolution. The resolution also urged upon the Congress of the United States the enactment of legislation designed to extend Federal credit facilities to solvent states, counties, and municipalities to enable them to carry on their normal programs of necessary and productive public works. The

appointment of a committee to take such steps as may be needed to make the principle operative in fact, was authorized.

The President appointed the following members to that committee: Messrs. John P. Hogan, Chairman; Harrison P. Eddy, Alonzo J. Hammond, Joseph Jacobs, and Malcolm Pirnie. The construction program and the Executive Committee's resolution appear elsewhere in this section.

Fall Meeting at Atlantic City

It was definitely decided to hold the Fall Meeting of the Society at Atlantic City, N.J., October 5–8.

Construction League of the United States

Carrying out the decision of the Board of Direction at its January 18 and 19, 1932 meeting, the Society joined the Construction League of the United States as one of its charter members.

Indiana Local Section

A petition received with the required number of signers for permission to form a Section of the Society to be known as the Indiana Section, was accorded approval.

Budget Reduced

Many administrative details received consideration, among others a reconsideration of the budget. Acting as the Finance Committee of the Society, the Executive Committee reduced materially several items of expenditure, as advisable in the present emergency.

Secretary's Abstract of Board of Direction Meeting, May 9, 1932

The Board of Direction, in accordance with the Constitution, met on May 9, 1932, at Society Headquarters. Present were President Herbert S. Crocker in the Chair; George T. Seabury, Secretary; Otis E. Hovey, Treasurer; and Messrs. Buck, Chester, Coleman, Holleran, Mead, Singstad, Slattery, C. H. Stevens, Stuart, and Tuttle.

William Barclay Parsons

Being informed of the death, on May 9 of Honorary Member William Barclay Parsons, the Board passed the resolution of regret which appears elsewhere in this section.

Unemployment Relief

The Board was in receipt of a communication from several members calling attention to the prospect of increased unemployment and distress among engineers during the coming winter and urging upon the Board the adoption of an administrative procedure to be carried out by the Society's Local Sections in all parts of the country.

J. P. H. Perry, M. Am. Soc. C.E., Chairman of the executive committee which has carried on the relief measures afforded engineers, both members and non-members of the four Founder Societies, in the New York Metropolitan area during the past winter, was present by invitation, and explained in detail the work and its results. The report to the Board on this work is given in detail on another page of this section.

Action on this communication was deferred until the next meeting of the Board, to be held July 4 in Yellowstone National Park, and the Secretary was instructed to secure from the Local Sections, for the information of the Board at that time, their estimates of the probable unemployment among members of the Society in their respective areas.

Adjournment

The Board adjourned to meet at Yellowstone National Park on July 4, 1932.

Engineers' National Relief Fund

In the interest of needy engineers who are members of the four Founder Societies, the Engineers' National Relief Fund has been established. Under this title, a committee has been functioning since last January. The work was started by the contribution of certain financial aid for engineers, to be distributed on a country-wide basis, originating in a gift from President Hoover. The total amount available outside the Metropolitan District for distribution through the Engineers' National Relief Fund was $5,683.35.

In its work, the committee was guided by certain policies aimed to make its resources felt most widely. At the outset it was realized that the fund was pitifully small for effective use on a country-wide basis. On the other hand, it was assumed that, in so far as possible, local sections would themselves take steps to relieve distress within their own membership. Hence it was decided that the Engineers' National Relief Fund should be used particularly for those cases in isolated communities which otherwise would not be immediately taken care of. Thus, by maintaining its resources as a continuously revolving fund, the committee would be able to spread its benefits over a wider territory, so that even if many engineers could not be helped at one time, at least a larger number could be assisted in succession.

Only cases of most dire distress are eligible. The member is required to give frank and confidential information regarding his financial status, including his funds, his property, his circumstances and responsibilities, and his other resources.

In this worthy endeavor, William G. Atwood, M. Am. Soc. C.E., represents the Society. The excellent work is being continued and the committee expects to give its best thought and assistance to any needs brought before it. Requests for information or aid may be addressed direct to Mr. Atwood at 39 Broadway, New York, N.Y.

Proceedings and Transactions

During June and July, Proceedings will not be issued to members. In those two months the papers to be assembled for the 1932 volume of Transactions are being reread, corrected, rearranged, and reprinted. Thus the period from August to May in each year forms a logical publication cycle for Proceedings. Papers that have been closed to discussion during that period are in line for final publication in Transactions, although not all of them will be accommodated in Volume 96.

Reviewing the year's work in Proceedings, the ten issues are found to contain a number of technical articles of outstanding merit—a symposium of two papers and 27 new papers, as well as three reports by committees, and a comprehensive bibliography. A number of memoirs have been preprinted in pamphlet form and this material is awaiting publication in Transactions.

That engineers are gaining a clearer perception of their responsibilities in contributing to discussion is testified by the fact that Proceedings had 254 discussers in the past ten issues as compared with 222 in the preceding year, and 21 authors closed their papers during this period. At least one closing discussion that arrived too late for the May Proceedings will be printed directly in Transactions. When the next, or August, issue of Proceedings appears, 26 live papers will still be open for discussion.

William Barclay Parsons, Honorary Member, Dies

Resolution Adopted in His Memory by Board of Direction at Its Meeting on May 9

The Board of Direction of the American Society of Civil Engineers has learned with deep regret of the death of one of the Society's most distinguished members, William Barclay Parsons. Since Mr. Parsons entered the Society in 1882, his fifty years of continued affiliation have been marked by outstanding service and achievement. His activities in the Society and his standing as an engineer were recognized in 1896 by his election to membership on the Board of Direction and again in 1925 by an award of Honorary Membership, the highest distinction in the power of the Society to bestow.

Throughout the years Mr. Parsons gave generously of his time and knowledge for the benefit of the profession. His contributions to the Society's publications constitute an invaluable addition to technical literature. During his entire engineering career he was almost continuously responsible for projects of such magnitude and

significance as will secure for him a place of lasting prominence in his profession. His entire career was one of energetic endeavor, and the value of his services was reflected by his selection for membership on numerous important boards and commissions, both engineering and civic, in America and abroad.

Conscious of his outstanding achievements and recognizing the great loss to the Society in his passing, the Board of Direction hereby records its profound appreciation of William Barclay Parsons as an illustrious engineer and eminent citizen.

Hints to Discussers

Certain facts relating to discussions in PROCEEDINGS should be brought to the attention of every member. First there is the obligation to contribute comments. Throughout its history the interests of the Society have been fundamentally technical, and its objective has been centered on the dissemination of technical knowledge and in recording such knowledge for reference. The PROCEEDINGS has always been, and will continue to be, a most important agency for carrying out these objectives. By the same token, papers in PROCEEDINGS serve their highest purpose when they inspire engineers to think about the subjects treated and to record their own ideas in the form of discussion. Thus discussion is the life of PROCEEDINGS, and to find discussers becoming more numerous each year is an encouraging sign.

But mere numbers of contributors or extent of contributions is not enough. In the present stage of the printer's art, the distribution of printed matter is too common and the volume of reading that faces the up-to-date engineer is too great. The Society, through its Committee on Publications, tries to be discriminating in the selection of material and sparing in the space allotted to any single article. Complex subjects are better treated in a number of single papers, perhaps only a few of which would be suitable for Society use.

To encourage more active participation in its affairs, the Society places fewer restrictions on discussers than on any one else. However, a few simple rules should assist the prospective contributor:

1. Be brief.
2. Discuss the paper; do not write an independent paper under the same title as the author's; "keep your eye on the ball."
3. Write in the author's language; do not confuse his paper by introducing new symbols for terms that have been previously defined by him or by using the same terms with other meanings.
4. Be as critical as you like, but refrain from personalities, stated or implied.

To the editors is given the sometimes onerous task of enforcing these regulations. Usually authors prefer to make their own corrections—if only they know the policy involved. It is hoped that this brief explanation will serve as a guide to prospective discussers, bringing the contributions more nearly within the defined scope of Society publications and assisting the editors immeasurably in their work.

Of interest in this connection is the pamphlet entitled "General Information on Society Publications and Preparation of Manuscript for PROCEEDINGS," copies of which will be mailed on request.

Ordering Reprints from Transactions

Because of unusual demands, actual and anticipated, the following timely notice to members is offered in the hope of saving them money on the cost of reprints from the forthcoming issue of TRANSACTIONS. This applies to orders of 25 copies or more. Now that Vol. 96 is being prepared for press, orders for reprints of papers, placed early, can be taken at merely the cost of materials and handling. The cost of composition and other fixed charges are paid by the Society.

The first papers, complete with discussion, that should be ordered at once to take advantage of reduced rates are "Analysis of Continuous Frames by Distributing Fixed-End Moments," by Hardy Cross, M. Am. Soc. C.E.; "Some Aspects of Water Conservation," by R. A. Sutherland, M. Am. Soc. C.E.; and "Run-off—Rational Run-off Formulas," by R. L. Gregory and C. E. Arnold, Associate Members Am. Soc. C.E. Special estimates will be furnished on request covering these or other papers.

Many structural engineers recently have been disappointed to learn that the reprint supply of Paper 1598 has been exhausted. They will be glad to learn of the possibility that this paper may be reprinted. The title of the paper is "Moments in Restrained and Continuous Beams by the Method of Conjugate Points," by L. H. Nishkian and D. B. Steinman, Members Am. Soc. C.E.

All who are interested in any of the foregoing papers should submit their inquiries at once. Reprint orders for papers in the forthcoming TRANSACTIONS other than those listed can also be placed at the present time. Where supplies of less than 25 copies are required, they will be cared for at the ordinary rate and from the surplus stock provided by the Society.

Committee on Municipal Cleansing Practice Formed

A Joint Committee on Municipal Cleansing Practice, for which the Sanitary Engineering Division of the Society made request two years ago, has been formed with the following personnel: George A. Soper, M. Am. Soc. C.E., Chairman; John H. Gregory and T. Chalkley Hatton, Members Am. Soc. C.E., representing the Society; George W. Fuller, M. Am. Soc. C.E., representing the American Society of Mechanical Engineers; Harrison P. Eddy, M. Am. Soc. C.E., representing the Public Health Association; Samuel A. Greeley, M. Am. Soc. C.E., representing the Society of Municipal Engineers; and Dr. Henry F. Vaughan, representing the American Medical Association.

In the course of its work the committee will investigate prevailing methods of street cleaning; the collection, transportation, and final distribution of garbage, ashes, and other solid wastes from cities and towns; the organization of street cleaning departments; the equipment employed by them; methods of superintendence and direction; and costs and recommendations for improvement along specific lines.

In view of the wide possibilities of these studies, it is believed that valuable results will be accomplished. Engineers interested in street cleaning and waste collection and disposal will await the report of this new committee in the anticipation that it will be of great value.

American Standards Association Projects Affect Civil Engineers

Since 1918, the American Standards Association has been a clearing house for the development of new engineering standards and for the dissemination of knowledge concerning existing standards. In reviewing the civil engineering projects now under consideration, the Association has reported the progress that has been made on them up to February 1, 1932. There are 26 of these projects that are a part of the present endeavor of the association. The Society has aided in sponsoring some of the work and its members are included in the personnel of the various committees making the studies. The specifications of the American Society for Testing Materials have been adopted in many instances.

Consideration is being given to standard specifications and standard test methods for portland cement. This work is sponsored by the American Society for Testing Materials, and W. K. Hatt, M. Am. Soc. C.E., is chairman of the committee.

Requirements for drain tile made of shale, fire clay, or surface clays, and of concrete, are being considered as a revision of the existing standard. The American Society for Testing Materials and the U.S. Department of Agriculture are joint sponsors, and Anson Marston, Past-President Am. Soc. C.E., is chairman of the committee.

Specifications for cast-iron pipe and special castings cover the unification of present forms including: materials, dimensions, pressure rating, methods of manufacture, elimination of unnecessary sizes and varieties, organic coatings and cement linings, and methods of making up joints in so far as they determine the dimensions. Thomas H. Wiggin, M. Am. Soc. C.E., is chairman of the committee.

A proposed American standard covering 13 types of manhole frames, 7 types of manhole covers, and hydrant and service valve

boxes, was completed in 1931. The committee has now begun to consider the correspondence which has been received relative to this proposed standard. The Society is acting as sponsor of this committee and its representatives are W. W. Brush and Robert B. Morse, Members Am. Soc. C.E.

A study of rivers, including the finding of units and bases of rating them for producing water power is being sponsored by the U.S. Geological Survey. Certain definite recommendations are being considered by the World Power Conference, after which the committee may be in a position to recommend an American standard. N. C. Grover, M. Am. Soc. C.E., is chairman of the committee.

Methods of testing road and paving materials are covered by one general project and three more specific projects, all sponsored by the American Society for Testing Materials. In 1930, after favorable action by the sectional committee and the sponsor, these test methods were adopted as American standards. P. J. Freeman, M. Am. Soc. C.E., is chairman of this committee.

The original recommendation regarding the simplification of sizes of spiral steel rods for concrete reinforcement was approved by the Association in 1927 as an American standard. Certain amendments are now to be considered for approval as a revision of the present standard. This study is sponsored by the U.S. Department of Commerce (Bureau of Standards) and the Concrete Reinforcing Steel Institute.

A digest of all 26 projects, contained in the March 1932 Bulletin of the American Standards Association, is available upon request to the Association at 29 West 39th Street, New York, N.Y.

Ambrose Swasey Honored by Franklin Institute

Ambrose Swasey, Hon. M. Am. Soc. C.E., and Founder of Engineering Foundation, was the recipient of the Franklin Medal of the Franklin Institute on its Medal Day, in Philadelphia, May 18. At the same time the Institute bestowed upon Dr. Swasey its Honorary Membership, the highest honor bestowed by the Institute. The medal was awarded to Dr. Swasey in recognition of the development of methods and the invention of appliances for making instruments of the highest precision, and for the design of the world's largest telescopes.

Student Chapter Conducts Section Meeting

For the May meeting of the Maryland Section an innovation was tried, in that the program was handed over to the Johns Hopkins University Student Chapter. Not only was the meeting conducted by the Student Chapter but the speaker of the evening also was a member of that organization. Details of this meeting will appear in the official report of Student Chapters in CIVIL ENGINEERING. It seemed to be the consensus of opinion that a meeting so arranged was exceedingly interesting and satisfactory. Possibly it will become an annual practice in the Maryland Section.

Other Sections may have tried this plan, but it was original as far as the particular Section and Student Chapter were concerned. It has the advantage of bringing the two groups close together to their mutual benefit. Credit is due to both organizations for the success in the present instance. The suggestion for the meeting came from W. T. Ballard, M. Am. Soc. C.E., Contact Member of the Student Chapter and president of the Local Section. W. Hobbs, Jr., presided for the Student Chapter and the speaker was R. B. Bortner, president of the Student Chapter. Information regarding this event was furnished by John H. Gregory, M. Am. Soc. C.E., Faculty Adviser of the Student Chapter.

Standards for Drainage of Coal Mines Published

A pamphlet on *American Recommended Practice for Drainage of Coal Mines*, published by the American Standards Association, is now available. It is based on the report of the committee appointed in 1929 by the American Mining Congress, composed of members representing the various engineering organizations.

This set of standards is one of several groups of national mining standards that are being developed under the auspices of the American Standards Association. It is a revision of a previous set for this important phase of coal-mine operation and is now accepted and approved by the Association for American practice.

The recommendations cover standardization of practice in the use of field pumps, permanent pumps, piping for pumps, operation of pumps, storage of mine water, natural drainage, unwatering of abandoned workings, and recommendations of metals and alloys with acid-resisting qualities. The American Standards Association is authority for the statement that nothing in the report is in conflict with existing state laws or regulations. The Society is represented on the committee by Charles Enzian and H. S. Smith, Members Am. Soc. C.E.

Model Registration Law Undergoing Revision

By a series of revisions, the model law for the registration of professional engineers and land surveyors, promulgated by the Society's Committee on Registration of Engineers, is approaching approved form. The first law was drafted in November 1929. This was revised the following December and further changed in March 1930, June 1931, and finally in April 1932.

At the latter meeting it was considered by a conference of representatives of 13 national societies and state organizations on April 15 last. By official action of that conference, it was:

"RESOLVED, To recommend the adoption of this Model Law for the Registration of Professional Engineers and Land Surveyors by all national, state, and local organizations of engineers as a model to be followed in the framing of all new registration laws and the amending of existing laws, with a view to attaining a uniform high standard throughout the United States."

In this present form the model law will be presented for approval to the Board of Direction and with its sanction it will be available for distribution to all interested organizations and boards.

Appointments of Society Representatives

GEORGE E. BEGGS, M. Am. Soc. C.E., was appointed to represent the Society at the first Congress of the International Association for Bridge and Structural Engineering, held in Paris, May 19–25.

WILSON T. BALLARD and T. L. CONDRON, Members Am. Soc. C.E., have been appointed Society representatives on the Policy Committee of the Construction League.

HARRISON P. EDDY, J. VIPOND DAVIES, AND CHARLES F. LOWETH, Members Am. Soc. C.E., were appointed to represent the Society on the joint committee of the Four Founder Societies on the Certification of Engineers into the Profession.

JOHN P. HOGAN, chairman; HARRISON P. EDDY, ALONZO J. HAMMOND, JOSEPH JACOBS, and MALCOLM PIRNIE, Members Am. Soc. C.E., have been appointed to serve as the committee to make operative in fact the Society's plan for a Normal Program of Public Works, as expressed by the Executive Committee's Resolution of May 9, 1932.

F. L. THOMPSON, M. Am. Soc. C.E., has been appointed as one of the Societys' representatives on the Washington Award Commission in place of DANIEL W. MEAD, Hon. M. Am. Soc. C.E., whose term has expired.

EDWARD H. ROCKWELL, M. Am. Soc. C.E., has been appointed as one of the Societys' representatives on the Division of Engineering and Industrial Research of the National Research Council.

RALPH J. REED, M. Am. Soc. C.E., has been appointed to the Society's Committee on Legislation.

R. K. TIFFANY, M. Am. Soc. C.E., and B. M. HALL, JR., Assoc. M. Am. Soc. C.E., has been named on the Sectional Committee of the American Standards Association on Rating of Rivers.

CHESTER L. POST and HERBERT J. GILKEY, Members Am. Soc. C.E., have been appointed on the Joint Committee on Standard Specifications for Concrete and Reinforced Concrete.

New York Engineers' Successful Efforts to Relieve Unemployed

Professional Engineers Committee Reports on Work Accomplished and Plans for the Future

By J. P. H. Perry, M. Am. Soc. C.E.
Chairman of Executive Committee, P.E.C.U.

In the February issue of Civil Engineering *there appeared an article outlining the organization, aims, and activities of the Professional Engineers Committee on Unemployment up to the middle of January 1932. It is believed that members of the Society in general, as well as the various committees scattered over the country that have been organized to deal with the relief of unemployed civil engineers, may be interested in this latest report of the work of the Professional Engineers Committee on Unemployment of the four Founder Societies in the New York Metropolitan District, known locally as the "P.E.C.U."*

The organization of the P.E.C.U. has been changed but very slightly from that described in my article in the February issue of Civil Engineering. The work has gone on steadily and fairly successfully. Up to May 14, 1932, our organization had registered unemployed members of the four Founder Societies and non-members to a total number of 2,689.

Of this total registration, 526 were not regarded as active applicants for relief since 139 had stated on a reclassification that they were definitely interested only in permanent engineering jobs, not in relief, and 249 had not replied to a series of letters asking if they still desired assistance, thereby indicating to the P.E.C.U. that they were no longer interested, while 138 had registered for educational courses.

Distribution of Registered Unemployed

Of the active registrants, totaling 2,163 men, P.E.C.U. has made 1,389 placements divided as follows:

On P.E.C.U. payrolls	307
Receiving other relief, such as that given by the Gibson, Bliss, and general public committees in the Metropolitan District of New York	879
In permanent engineering jobs	203

The division among society members and non-members, both for registrations and placements, is as follows:

The Division Among Society Members and Non-Members

Society	Registered	Percentage of Total Registration	Placed	Percentage of Total Placed	Percentage of Registered Placed
American Society of Civil Engineers	239	11.0	184	14.9	77.0
American Institute of Mining and Metallurgical Engineers	35	1.6	31	2.8	88.6
American Society of Mechanical Engineers	345	15.9	248	20.2	71.9
American Institute of Electrical Engineers	210	9.6	157	12.7	74.8
Western Society of Engineers	4	0.2	4	0.3	100.00
Non-Members	1,339	61.7	603	49.1	45.03
	2,172	100.0	1,227	100.0	
Duplicate Memberships	9		7		
	2,163		1,220		
Men placed more than once			169		
Total			1,389		

The analyses of registration and placements by married and single classifications and also by groupings of salaries received by the registered man in his last employment, are shown in the following tabulations:

Marital Status	Registered		Placed
Single	648		228
Married	1,431		964
Widower	33		18
Divorced	29		10
	2,141		1,220
Unaccounted for	22	Replacements	169
Totals	2,163		1,389

Salary	Registered		Placed
\$6,000 or better	127		92
\$3,600–\$6,000	505		352
\$2,400–\$3,600	1,016		576
\$2,400 and below	493		200
	2,141		1,220
Unaccounted for	22	Replacements	169
Totals	2 163		1,389

Men Placed in Many Different Types of Work

Many readers may be curious as to what class of work the P.E.C.U. has been able to find for the 1,389 engineers that it has placed in jobs. These men have been doing useful work, which may be classified as follows:

Gibson Committee (Emergency Work Bureau) *380*

Borough of the Bronx—surveyors
Borough of the Bronx, Department of Water Supply—men employed on surveys, drafting, general utility work
Borough of Brooklyn, Department of Parks—instructors for playgrounds, draftsmen, gymnasium instructors
Borough of Richmond—surveyors
Department of Hospitals—men employed on mechanical plans and specifications
Municipal Building—plan examiners
Traffic survey, New York and New Jersey, under the supervision of the Port of New York Authority
Borough of Manhattan—surveyors
New York University—assistant professors, stock men, general office workers
College of the City of New York—draftsmen, laborers, stock men assistant professors
Board of Education—assistant truant officers, census of school children
Department of Docks—construction inspectors
Block-Aiders—collecting city relief funds
Home relief investigators

Bliss Committee (City Commission Work Bureau) *352*

Home office staff—key men in home organizations, timekeepers, checkers, payroll men, paymasters, and others
Field—The men of the Bliss Committee (City Commission Work Bureau) have been engaged in work assigned to them by the heads of the various city departments concerned

The Temple Act (Geological Survey) *30*

Men engaged in a topographical survey, bringing the old topographical sheets up to date or making new ones, largely in lower Westchester County, Queens County, New York County, and a part of Bergen County, N.J.

The Nassau County Relief Organization *44*

Men employed in surveying outlying districts and establishing bench marks

The Westchester County Park Commission *64*

Men employed in Saxon Woods and Woodland Lake Park as wood cutters, cleaning up underbrush, and on general laboring work

The Bergen County Relief Commission *4*

Surveyors, establishing bench marks throughout Bergen County

Other Relief Work in New Jersey *3*

Men doing general laboring work in towns and municipalities

Yonkers Emergency Work Bureau *2*

Men employed in routine laboring jobs, in the schools, and in police stations

P.E.C.U. Salaried Workers *59*

Home office staff—employed in interviewing, registering, classification, placement, payroll, consultation bureaus, investigations, and soliciting funds

Other organizations (paid direct by P.E.C.U.) *248*

American Society of Mechanical Engineers—men employed compiling data on mechanical engineering subjects
American Institute of Mining Engineers—men employed compiling data on mining and engineering subjects
College of the City of New York—draftsmen, labor foremen, translators, instructors, map makers, machinists, and general assistants to the professors and college staff
Engineering Societies Employment Service—men employed in soliciting and investigating engineering jobs
Engineering Societies Library—men employed in the book-binding department, classification department, research department, and translation department
Heating and Piping National Contractors Association—men employed in compiling statistics on heating and piping subjects
Malone and Graham—men employed in selling a speed reduction device for automobiles and trucks

Modern Radio and Electrical Company—men employed selling Westinghouse refrigerators
New York University—library assistants, assistants to the general staff, instructors, machinists, draftsmen, and men employed in other capacities
New York Museum of Science and Industry—men employed as mechanical and electrical draftsmen, guards, and guides, and in the preparation of displays depicting the progress of automotive, aviation, railway, textile, electrical, agricultural, and mining industries
(These men are performing work which the museum could not afford to have done in normal times because it could not pay the wages that would be demanded by the type of men that we have placed with it. We also have several men with this organization acting as cabinetmakers, lathe hands, machinists, and porters.)
New York Public Library—guards, book binders in the repair department, and assistants in the boiler room, in the administration offices, in the classification department, in the periodical department, and on the exhibits
P. H. Harrison and Company—men employed in the sale of General Electric refrigerators and General Electric heat control equipment
Rex Cole and Company—men employed in the sale of General Electric refrigerators
Stevens Institute—draftsmen, smoke abatement experts, translators, tracers, labor foremen, assistants in the administration and executive offices, laboratory assistants, and instructors in classroom and laboratory work

Permanent engineering jobs 203

These engineering positions included drafting, designing, surveying, and engineering sales work. Some of the men are acting as curators of museums, as laborers, stokers, apartment house superintendents, oilers, teachers, timekeepers, meter testers, renting agents, and solicitors for magazine subscriptions. Obviously some of these are not engineering activities, but they are classified under the heading, "Permanent Jobs."

SOURCES OF FUNDS

The registering and placing of these men has been made possible through the Finance Committee, which under the intelligent leadership of Mr. Kidder raised $107,841.69 in cash and pledges, about 90 per cent of it from members of the four Founder Societies. This money has come from 3,286 individuals. The number of contributors and the amount individually contributed by the memberships of the four Founder Societies may be classified as follows:

	No. of Contributors	% of Total	% Membership in P.E.C.U. Territory	Total Contributions	% Total Contributions in $	Average Contributions
Civil	750	22.8	22.4	$35,537.81	32.9	$47.4
Mechanical	1,056	32.2	38.3	20,355.51	18.9	19.2
Electrical	1,056	32.2	30.4	25,639.86	23.8	24.2
Mining	240	7.2	8.9	11,802.97	10.9	49.2
Miscellaneous (largely firms or corporations or nonmembers of Founder Societies)	184	5.6	...	14,505.54	13.5	79.5
	3,286	100%	100%	$107,841.69	100%	$32.82

The canvassing for this money was done in three ways: by letters of appeal; by unemployed engineers as canvassers or solicitors, they being paid the relief wage; and by voluntary committees of members of the societies doing personal canvassing. The letters of appeal were four in number. The first went to the entire membership of the four Founder Societies in the Metropolitan District of New York to a total number of nearly 13,000. The second went to all who had not replied to the first, and similarly the third and fourth were sent to those who had not replied to the preceding letters, it being necessary to mail but 5,400 copies of the last letter.

Our list of engineers was divided into two classes: (1) a special group supposed to contain the more affluent members of the profession, to a number of 571; and (2) the remainder of the members. Contributors on the special list to the number of 183 gave $30,526.60, or an average sum of $166.80 each. From the rest on the general list, 3,103 individuals gave $77,315.09, or an average of $24.92. The general average from the 3,286 individuals who contributed was $107,841.69, or approximately $32.82 each.

Of this $107,841.69, about $20,000 was originally in the form of subscriptions or pledge cards, the donor electing to contribute on a monthly or weekly basis over varying periods of time, some as long as five months. To date only $7,000 of these pledges is unliquidated and experience indicates thus far that only about $1,000, or roughly 5 per cent of the total number of pledges are in default. In nearly every such case the pledger has lost his job since undertaking his obligation.

TOTAL SUMS OBTAINED BY THE P.E.C.U.

Raised directly in cash and pledges	$107,841.09
Obtained in the form of contributions of second-hand clothing of an estimated second-hand value of	4,500.00
Unexpended balance available from a joint appropriation from the State of New York through the Straus Committee and from the U.S. Geological Survey under the Temple Act	11,330.00
Raised separately for administrative purposes to cover such items as postage and telephones (Administrative funds were contributed principally from the treasuries of the local sections of the four Founder Societies)	5,247.00
Obtained from President Hoover and from the Engineers' Club of New York for the relief of engineers outside the Metropolitan District of New York	5,700.00
Total wages paid to date by semi-public bodies to P.E.C.U. engineers at the instigation of the P.E.C.U. One of the main accomplishments of the P.E.C.U. has been its success in arranging with the general relief agencies in New York, notably the Gibson and Bliss committees, to take over 800 unemployed engineers and put them on their relief payrolls	307,119.00
Grand total raised by the P.E.C.U. and either paid out in wages to date or still available for relief work, plus wages paid or available to be paid to P.E.C.U. engineers from other bodies	$441,737.69

TYPES OF RELIEF PROVIDED

The average relief afforded the individual unemployed engineer through the P.E.C.U. has been $19.05 per week. This sum has varied somewhat depending upon where the relief was obtained. The average under different conditions varied as follows:

For those paid direct through P.E.C.U.'s payroll	$18.82
For those who obtained relief through the Gibson, Bliss, and other relief committees	$21.50
For those who got engineering jobs through the P.E.C.U. and other sources	32.50

There have been 73 loans granted in amounts in excess of $15, totaling $3,355, and averaging $45.18 per man. There have been 60 emergency loans granted in amounts less than $15, totaling $248 and averaging $4.13 per man.

These loans were on demand notes without interest. The expectation is that ultimately a considerable percentage of the borrowers will repay them. The notes are made payable to the United Engineering Trustees, Inc., the official treasurer of the P.E.C.U. Should these loans be repaid, the funds collected will be reserved in a permanent fund to be managed by the presidents of the four local sections of the four Founder Societies for the relief of destitute engineers, or they will be held in reserve to meet another business depression.

The relatively small number of loans made and the meager sums of money required surprised those active in the P.E.C.U. At the inception of our organization the forecast was that the loaning of money would be one of our chief activities. Apparently engineers (especially our members) are extremely loath to apply for loans. They much prefer wages from made work or even direct relief from city bureaus. Also, a loan meets only the momentary emergency, whereas a wage, even at a trifing rate, makes possible the planning of one's life. Loans, to be satisfactory, must be at a continuing rate, and this is impossible, in our experience, to contemplate.

In addition to its other activities, the P.E.C.U. has been very active in using the influence of its personnel to persuade the gas and electric light companies to forebear as far as possible enforcing routine orders to discontinue their services to destitute engineers who were being aided in other ways by the P.E.C.U. In some instances it has been possible to persuade holders of mortgages to be more lenient in the terms on which they extended or renewed them. Occasionally money has been loaned to pay interest on mortgages.

A legal aid department has been established, whose function has been to give free legal advice to registered unemployed whose circumstances were such that they required such advice. Similarly, an agency has been set up to assist registered unemployed who had developed inventions or processes possibly warranting patents. Occasionally the P.E.C.U. has been of help through various hospitals in the city in getting special terms or special admittance for its registered unemployed.

It has been found that many unemployed engineers lack the knack of writing suitable and effective letters applying for jobs. Engineers seem to have difficulty in "selling" themselves. There-

fore the P.E.C.U. organized a little department, the function of which has been to help registered men prepare letters outlining their past experience in a way to interest the prospective employer. This has been supplemented with a mimeographing service to produce multiple copies of such letters.

Another way of stating P.E.C.U.'s accomplishments is that through February, March, and April it was responsible for building up a payroll of about $21,000 a week for unemployed engineers. Of this, about $4,000 was met directly by the P.E.C.U. from its own funds; the balance, by public or other agencies.

As regards clothing, in the early winter the McGraw-Hill Company generously donated floor space in its building on West 42d Street. Two unemployed engineers were set to work to operate this clothing bureau. To date 203 men, 61 women, and 58 children have been provided with clothing, which has been contributed largely through the kind efforts of the Engineering Woman's Club of New York. This clothing has been a godsend to many unemployed men, who, if they had not had the clothing from the P.E.C.U., in many cases could not have taken the positions which were found for them.

The Engineering Woman's Club not only did a splendid work in collecting and distributing clothing but also initiated and managed in a fine way a charity bridge party which was held in the rooms of the Engineering Societies Building. Some 700 tickets were sold at $2 apiece, and between 400 and 500 members of the Founder Societies played bridge one evening. The result was that a net contribution of $1,160 was made to the funds of the P.E.C.U. This report would not be complete without including words of warm appreciation and gratitude to the officers and members of the Engineering Woman's Club for their active assistance to the P.E.C.U. throughout the past winter.

Another successful activity of the P.E.C.U. was that of certifying unemployed engineers to Columbia University so that they could attend classes without academic credit and without expense. Early in the campaign it was felt that in addition to affording financial relief to unemployed men, we must do something to sustain the morale of those who were not as yet in dire need of financial relief. Columbia University responded very generously to the suggestion, and to date we have sent there 138 men, who made 564 registrations in 163 different courses for the winter and spring terms. The subjects elected by these men cover a wide range. They may be summarized briefly as embracing architecture, chemistry, civil engineering, electrical engineering, industrial engineering, geology, mechanical engineering, mathematics, languages, metallurgy, mining, physics, accounting, finance, industrial relations, and economics.

Another important committee which was recently established is known as the Committee on Industrial Opportunities. This committee endeavors to place engineers outside the profession. It has prepared a list of some 800 industrial concerns which in its judgment could use engineers for cost studies and in other ways where their technical training and mathematical ability would make them more useful than the ordinary layman. This committee plans to continue its work all summer, and has been reinforced by two other groups who will solicit positions of a permanent nature.

Advertisements in the daily and technical press are being posted on a bulletin board in the Engineering Societies Building, and, as has been mentioned, assistance is being rendered in preparing letters of application.

More Money and Jobs Needed

Members of the Society will greatly assist the P.E.C.U. if they will kindly inform the Committee on Opportunities in Business and Industry of any positions they may know of that might be filled by a man with engineering training. Such information, addressed to the Professional Engineers' Committee on Unemployment, 29 West 39th Street, New York, N.Y., will be gratefully received and given prompt attention. Considerable success in a preliminary way has rewarded this committee under the intelligent leadership of Ralph T. Rossi.

Another committee, known as the Committee on Construction Legislation, under the able leadership of Malcolm Pirnie, John P. Hogan, and R. C. Marshall, Members Am. Soc. C.E., has been active in Washington and Albany in endeavoring to persuade Congressmen and other legislators that the cutting out of construction enterprises from Federal, state, and municipal budgets is fallacious economy, results in great increase in unemployment, and is particularly distressing to engineers. It is believed that the work done by this committee has been, or will be, fruitful in part.

Reviewing the activities of the past seven months, the greatest accomplishment of the P.E.C.U. has been to convince the semi-public relief agencies in the Metropolitan District of the desirability, from their point of view, of using unemployed engineers in supervising capacities or as key men in directing the 35,000 or 40,000 individuals to whom these agencies have had to give unemployed relief in the form of made work or as direct relief in New York this past winter. Extreme care was taken in certifying P.E.C.U. registrants to these public bodies, notably to the Gibson and Bliss Committees, to make certain that the candidates sent down for employment were qualified for the job in question.

A large part of the work of the Registration Committee, ably led by Ernest S. Holcombe, as a part of the General Relief Committee under the fine management of George L. Lucas, M. Am. Soc. C.E., has been to classify all registrants as to their prior experience and their fitness for different types of work. In other words, it was a "selling proposition" and we had to be sure that the goods we were offering were satisfactory. Our care along these lines in the early stages of our activities has been rewarded many times over. The fact that wages paid by these relief agencies to our unemployed engineers totaled $307,119 is distinctly "proof of the pudding."

Although the raising directly by P.E.C.U. of $107,841.69 may be regarded as satisfactory, it is only proper to call attention to the fact that this has come from only 3,286 men out of over 12,000 members of the four Founder Societies in the Metropolitan District, to say nothing of an estimated non-membership of at least 10,000 more. This estimate is based on the fact that our registrations indicate that the division between members and non-members among unemployed engineers is almost exactly half and half. It is also distressing to report that in spite of four letters of appeal, over 5,000 members of the societies failed to reply in any way. Some 4,000 members who did not contribute did accord the P.E.C.U. the courtesy of acknowledging its appeals and giving reasons why they could not contribute. In most cases the reason for non-contribution was loss of job or extreme outside relief burdens to which the member was committed.

Plans for the Future

As to the immediate future, the Relief Committee after mature study submitted a written report to the Executive Committee, which in turn, after consideration, made a written recommendation to the General Committee to the effect that registration of unemployed engineers should cease April 9. The General Committee unanimously approved the recommendation. The branch offices of the P.E.C.U. in New Jersey and in Westchester and Nassau counties in New York State were closed on the same date. A nucleus of the normal staff of some 60 paid and volunteer P.E.C.U. workers on registration, classification, vital statistics, certification of unemployed to vacant jobs, and other work will be maintained until October 1 to the number of about 16.

Announcements were sent out giving two weeks' notice to unemployed non-members that they were to go off the P.E.C.U. payrolls on April 15; a month's notice was given to married non-members and unmarried members that they would go off the P.E.C.U. payroll on May 1; and a month's notice was given to married members other than those falling within Class A destitution that they would go off the payroll on May 15.

A reserve of money to start up the activities of the P.E.C.U. on October 1 was set aside and the remainder of its funds were held to take care of married members in Class A destitution from May 15 to October 1. The general feeling of those active in the P.E.C.U. is that the problem of relief for unemployed engineers will be more serious in the winter of 1932–1933 than in the past winter and that the number of members of the four Founder Societies falling within Class A destitution will increase throughout the summer months, not only because of the tapering off of direct relief from the P.E.C.U. but also because of the laying off of the engineers placed through the P.E.C.U. with other relief agencies in New York City, notably with the Gibson and Bliss committees, which began to occur in April and will continue throughout the summer, and further because of the continued loss of employment by engineers throughout the summer months.

It was felt that above all the P.E.C.U. must keep itself in such financial condition that it can take care of all married members of the four Founder Societies whose situation now places them, or may place them within the next few months, within our Class A

destitution. To be in Class A destitution a man must have three or more dependents, must have exhausted all personal resources and all personal credit. He may be briefly described as one with his back to the wall.

Starting in October 1931, the P.E.C.U., on instructions from the four Founder Societies, rendered assistance to members and non-members without discrimination. About February 8, when we had more knowledge of the problem confronting us, the Executive Committee, with the support of the General Committee, reached the conclusion that inasmuch as substantially 90 per cent of the money contributed to the P.E.C.U. had come from members of the four Founder Societies and yet more than 50 per cent of its registrations and more than 50 per cent of its placement of unemployed engineers had been of non-members of the Societies, it was necessary from that date on to use the funds contributed to the P.E.C.U. only for the assistance of members or former members of the four Founder Societies. We continued, however, to place our registered men with public or semi-public agencies without discrimination between members and non-members. In the face of present conditions, the decision has been made that the P.E.C.U. will use its own funds only for the relief of members of the Founder Societies. In deciding for the present to relieve only Class A destitute married members, we interpret the word "married" to include a single man with dependents. We also interpret "members" to include former members of the Founder Societies whose membership ceased because of their loss of position and inability to pay dues.

In concluding this report, on behalf of the General and Executive Committees of the Professional Engineers Committee on Unemployment, I desire to make public our gratitude to the rank and file of our organization, including particularly the committee chairmen, who have done such splendid work and have given of their time and energy so unselfishly and with such splendid results. I believe that the thanks of the four Founder Societies are also due to all these men.

Memoirs Available on Request

Since May 1931, the policy of publishing biographical sketches of deceased members in PROCEEDINGS has been abandoned. Instead, these memoirs are issued in preprint form and later included in TRANSACTIONS. From time to time announcement is made in CIVIL ENGINEERING of the memoirs that are available as preprints, and these are sent, on request to Headquarters, to any one who desires them. Eventually, of course, they will form a part of the permanent reference library of all members and subscribers in TRANSACTIONS.

Since the previous list appeared, in the November 1931 issue of CIVIL ENGINEERING, the following memoirs have been put in preprint form and added to the list of those available on request:

Edward Dean Adams	Montgomery Meigs
Peter Christian Asserson	Bernard Joseph Merickel
Frank Harrison Bailey	John Harry Miller
James Wartelle Billingsley	Eusebius Joseph Molera
William Algernon Brackenridge	Stephen Henley Noyes
Howard Adams Carson	Frederick Sylvester Odell
Edward Carlos Carter	Arthur Onderdonk
James Retzer Comly	William Collins Phelps
Charles James Craigmile	Henry Tegmeyer Porter
William Warren Cummings	Harry Longyear Preston
Sverre Dahm	Albert Reesor Raymer
John Stanley Dawson	Homer Austin Reid
Robert Morris Drake	Knud Sophus Riser
George Ezra Ellis	Philip Schuyler
Frank Collins Emerson	Edward Alfred Simmons
Hermann Fougner	Willis Appleford Slater
Edward Gagel	Herbert Jones Sowden
James Henry Gallivan	Eugene Washington Stern
Edward Willard Howe	Frank Stoddard Stevens
William Josiah Karner	Lewis Thornburg
Alfred Lawrence Kehoe, Jr.	George William Volckman
Elmer Barthold Lawson	Samuel Tobias Wagner
William Henry Lawton	Andrew Jackson Wiley
Ernest McCullough	Henry Dickinson Woods
Milo Stuart MacDiarmid	Charles Worthington

Copies of these biographical sketches have already been sent to the immediate families of these members, and to the members and friends who wrote the memoirs or collaborated in their preparation. However, there will be many others who will recognize in this list the names of close friends and respected colleagues, and who will welcome this opportunity of securing biographical material on lives of rich social worth and high professional achievement.

News of Local Sections

Central Ohio Section

The speaker of the day at the April 14 meeting of the Central Ohio Section, held in Columbus, was R. C. Atkinson, of the Ohio Institute, whose subject was "The Problem of County Reorganization." In his address, Mr. Atkinson outlined the inadequacies of the present system of county government and commented briefly upon the engineer's importance in county organization.

Cincinnati Section

A well attended dinner meeting of the Cincinnati Section was held at the university Y.M.C.A. on April 28. There were a number of distinguished guests present, among them, Brig. Gen. T. H. Jackson, C.E., U.S.A., president of the Mississippi River Flood Commission, who was the speaker of the evening. The following officers were elected for the coming year: Henry H. Kranz, President; John M. Belknap, Vice-President; and Clifford N. Miller, Secretary-Treasurer.

Connecticut Section

The speaker of the evening at the April 20 meeting of the Connecticut Section, held in Hartford, was Prof. Richard S. Kirby, of the Civil Engineering Department of Yale University, who spoke on "Epochs of Civil Engineering History." Professor Kirby's talk, which was illustrated with lantern slides, provided an interesting and instructive hour. The following officers were elected for 1932: Charles E. Smith, President; William R. Copeland, Vice-President; and Joseph P. Wadhams, Secretary-Treasurer.

Dayton Section

At the regular monthly meeting for April, Prof. W. R. Pyle, of Wilmington College, gave a talk on "Magnetism and Photo-Electricity," in which he demonstrated the scientific and industrial uses of magnetism and photo-electricity and the possible future applications of each. Members of the Student Chapters of the University of Dayton and Antioch College were guests at this meeting.

District of Columbia Section

Members of the Maryland and Virginia Sections were guests at a smoker held by the District of Columbia Section in Washington, on Friday evening, April 8. The speaker of the evening, J. Trueman Thompson, Professor of Civil Engineering at Johns Hopkins University, addressed the meeting on the "Development of the Art of Building." The talk was illustrated by lantern slides. Over 100 members and guests attended.

Duluth Section

At its January 20 meeting, the Duluth Section was addressed by H. C. Walker, of the U.S. Engineers' Office in Duluth. The subject of Mr. Walker's talk was "Aerial Mapping as Developed and Used by the U.S. Government." The February meeting was devoted to the subject of the bi-centennial celebration of the birth of George Washington. A talk by Attorney Dennis Donovan on "George Washington as the Engineer," was greatly enjoyed by all.

On March 21, John Wilson, City Engineer of Duluth, gave an interesting description of the new sewage disposal plant which is now being constructed in Duluth; and at the meeting held on April 18, George C. Newton, of Iron Mountain, Mich., discussed the controversies between Canada and the United States over the rights of private land owners in and on the boundary lakes and rivers, where power developments have raised or have proposed to raise the natural water levels.

Ithaca Section

On April 22, the Ithaca Section held a dinner meeting at which 31 members and guests were present. The speaker of the evening was Henry W. Troelsch, who gave a very interesting and instructive talk on "The Erection of the Kill van Kull Bridge."

Los Angeles Section

The guest of honor at the April 27 meeting of the Sanitary Group was A. L. Sonderegger, president of the Los Angeles Section. In a brief address, Mr. Sonderegger pointed out the change in the trend of engineering activities, due to changing requirements and conditions. "Methods of Sewage Aeration" was the subject of a talk by S. M. Bennett, of the Department of Water and Power, City of Los Angeles; and interesting papers on the "Excess Lime Plant at Boulder City" and the "Sanitary Quality of Flood Water" were presented by E. M. Kelly, of the Dorr Company, and F. Laverty, engineer with the Los Angeles County Flood Control District, respectively. The meeting was closed with "A Symposium of Unique Ideas in Design and Construction of Sewers."

Louisiana Section

There were 47 members and guests in attendance at the annual meeting of this Section, held in New Orleans on April 20. Brief remarks were made by John F. Coleman, Past-President of the Society; Allan T. Dusenbury, Director; and Douglas Anderson, Dean of the College of Engineering, Tulane University. Election of officers for 1932 resulted as follows: George P. Rice, President; John Riess, First Vice-President; P. D. Cook, Second Vice-President; John H. O'Neill, Secretary; and R. L. Moroney, Treasurer.

Metropolitan Section

The regular meeting for April was called on April 20, 1932. The president of the Section, George L. Lucas, reported briefly for the Professional Engineers Committee on Unemployment. Members of the committee which will nominate officers for the forthcoming year were duly chosen as follows: George H. Pegram, Robert Ridgway, H. D. Winsor, J. J. Yates, and J. P. Hogan.

A symposium on sewage disposal problems in the Metropolitan District was presented. The principal speaker was Leonard C. L. Smith, engineering member of the Sanitation Commission of the City of New York, who outlined the progress of the New York City Department of Sanitation. Other speakers were Charles A. Holmquist, Director, Division of Sanitation, New York State Department of Health, who discussed the question from the standpoint of the state's interest, and Gerald W. Knight, who spoke of the activities of the Tri-State Pollution Commission in New Jersey. Further discussion was offered by Joseph P. Day, chairman of the commission, and G. A. Soper, formerly a member of the Metropolitan Sewerage Commission, who rounded out a general treatment of the Metropolitan District sanitation problems. At the conclusion of the meeting, refreshments were served. The attendance numbered about 325.

At the annual meeting of the Section, held on May 18, the program was devoted to a discussion of the recent action of the Society in support of a normal program of public works for the relief of the economic depression. Talks were given by Stuart Chase, writer and economist; Wilfred I. King, Professor of Economy at New York University; Dr. Virgil Jordan, economist; Col. John P. Hogan; and Willard Chevalier. The Section passed a resolution endorsing and supporting the Society's program. The annual election of officers for the Section resulted as follows: Malcolm Pirnie, President; Thaddeus Merriman and Van Tuyl Boughton, Vice-Presidents; and William J. Shea, Secretary. O. H. Ammann, W. L. Hanavan, and E. R. Needles were elected directors of the Section.

Mid-South Section

The third annual convention of the Mid-South Section, held in Little Rock, Ark., was opened on the morning of April 29 by the president of the Section, Harry N. Howe. Following the appointment of committees, T. R. Agg, Professor of Highway Engineering, Iowa State College, gave an address on "Highway Transportation." At the luncheon, held at the Little Rock Engineers' Club, E. N. Noyes, consulting engineer of Myers, Noyes, and Forrest, in Dallas, spoke on "The Engineer in Community Life," after which Dr.-Ing. Herbert D. Vogel, 1st Lt. C.E., Director, U.S. Experiment Station, Vicksburg, Miss., spoke on "Special Problems Encountered at the U. S. Waterways Experiment Station." At the business meeting, election of officers for 1932 was held with the following results: Roy E. Warden, President; W. E. Elam, T. B. Larkin, Kenneth Markwell, W. A. K. Parkin, W. R. Spencer, and Alfred M. Lund, Vice-Presidents; and George R. Clemens, Secretary-Treasurer.

Guests at the banquet held that evening were: Herbert S. Crocker, President of the Society; H. M. Waite, Vice-President of the Society; E. B. Black, consulting engineer, Black and Veatch, Kansas City, and D. A. MacCrea, consulting engineer, Ford and MacCrea, Little Rock, directors of the Society. An address by Dr. A. W. Jamison, Professor of Economics, University of Arkansas, on "Some Economic Aspects of Engineering" was thoroughly enjoyed by all present.

Philadelphia Section

The Student Chapters meeting of the Philadelphia Section was held on April 21. The marked increase of interest in engineering in schools and colleges was commented on by I. S. Walker, consulting engineer, who was chairman. After this Willard T. Chevalier, Publishing Director, Civil Engineering and Construction Publications, McGraw-Hill Publishing Company, gave an excellent informal address on economics and the engineer. Entertainment was provided by members of the Student Chapters of the Drexel Institute, University of Pennsylvania, Pennsylvania Military College, and Villanova College.

Portland (Ore.) Section

A meeting of this Section was held on February 11 at the University Club. After the business session an interesting and informative talk on the Panama Canal and the proposed Nicaragua Route was given by Maj. Oscar O. Kuentz, District Engineer, Corps of Engineers, Portland.

On March 24, Brian Sherar, an engineer with Wallace and Tiernan Company, Seattle, gave an interesting talk on "Some Phases of Modern Water Treatment," and showed the chlorination equipment of the Portland Water Bureau.

Porto Rico Section

This Section held its quarterly meeting in San Juan on March 12. Following the business session which occupied a large part of the meeting, a technical paper was read on Ponce Pier. On March 20, an excursion trip was taken along the lines of the American Railroad Company. This was made possible through the courtesy of Emilio S. Jiménez, general manager of the company.

Recent Excursion of the Porto Rico Section

Sacramento Section

A report from the Sacramento Section indicates that recent meetings have been very well attended. On March 15, William S. Guilford, of the California National Bank, gave an address on "The Trust Department of a Bank." At the next meeting, held on March 22, Leonard F. Sparks, architect for the new $1,250,000 Federal Building in Sacramento, described the work of preparing plans for the building. "Nevada: The Land of Ghost Cities," was the subject of an address by Herbert C. Davis, mining engineer, on March 22; and A. Kempke addressed the April 5 meeting on the subject of "The Santiago Creek Earth-Fill Dam." Motion pictures of the construction and trial trip of the Goodyear Zeppelin, "Akron," were shown on April 12; and those in attendance at the April 19 meeting heard a paper on "The Influence of Engineering on Traffic Safety," read by E. Raymond Cato, chief of the state traffic control. The speaker at the meeting on April 26 was Roy P. Womack, of the State Department of Agriculture, who chose as his subject, "Chemistry in Agriculture."

San Francisco Section

The 161st regular meeting of the San Francisco Section was held on Tuesday evening, February 16. After a short business session an interesting talk on "Two Years in Turkestan" was given by A. P. Davis, consulting engineer. There were 156 members and guests in attendance at this meeting.

Seattle Section

Following the business session at the April dinner meeting of the Seattle Section, Samuel J. Humes, Director of Highways, State of Washington, gave an interesting address on "Highways in Washington." There were 42 members and guests in attendance.

Spokane Section

At the April 15 noon meeting of the Spokane Section, E. G. Taber, Chief Engineer of the Spokane International Railway, gave a very interesting discussion of the present economic situation of the railroads.

American Engineering Council

National representative of 27 engineering societies, with a constituent membership of 60,000 professional engineers, reports civil engineering news of the Federal Government

Public Works Administration

The possibility of securing a Public Works Administration during this session of Congress was greatly enhanced by the action of the House of Representatives on the Omnibus Economy bill. The committee estimated the total economies to be effected would approximate $200,000,000. After a very stormy session, the House struck from the bill most of the economies, leaving in it savings estimated at about $68,000,000. Many features of this bill are of interest to engineers.

The House, in passing the Omnibus Economy bill, gave every Federal employee an exemption of $2,500 per year. Above that amount the salaries are to be reduced for the year 1933 by 11 per cent. The Federal Government engineers, now numbering 7,000, do not expect, and have not looked forward to, the receipt of large compensation but they have always had reason to believe that they had both permanency and security in their employment. This action of the House of Representatives shows that assumption to be no longer justified.

The Omnibus Economy bill as passed by the House gives the President authority to group, coordinate, and consolidate the executive and administrative agencies of the Government as nearly as may be, according to major purpose; to reduce the number of such agencies by consolidating those having similar functions under a similar head; to eliminate overlapping and duplication of effort; and to segregate regulatory agencies and functions from those of executive and administrative character. The bill authorizes the formation of the Public Works Administration under an Administrator of Public Works, who shall hold office for six years and receive a salary of $10,000 per year. The river and harbor activities of the War Department are excluded from this Public Works Administration.

Society for Promotion of Engineering Education Joins

Final arrangements have been completed whereby the Society for the Promotion of Engineering Education becomes a member organization of the American Engineering Council. The Society for the Promotion of Engineering Education, the foremost exponent of engineering education in the United States, is composed of 2,274 members, largely teachers and professors in engineering colleges. Dean F. L. Bishop, for many years its secretary, has been chosen as its first delegate to the Assembly of the Council.

Supreme Court Upholds President Hoover

The Supreme Court of the United States recently upheld the legality of the appointment of Dr. George Otis Smith as a member of the Federal Power Commission. At the time of the reorganization of this commission, President Hoover nominated Dr. George Otis Smith to be chairman of the commission. The Senate confirmed this nomination and sent a written statement certifying it to the President. Dr. Smith took the oath of office, but because some of his first acts displeased members of the Senate, an effort was made to recall his nomination.

Muscle Shoals Bill Passed by House

On May 5 the House of Representatives, by a vote of 163 to 132, passed the perennial Muscle Shoals Bill, H.R. 11051. This bill is in many respects similar to the one vetoed by President Hoover last year. The measure provides that the Government may lease the Muscle Shoals properties under certain conditions, and that, in the event of its inability to lease the properties after a given time, they shall be operated by the Government.

Progress Report on Consumption, Production, and Distribution

A progress report of the Council's Committee on the Relation of Consumption, Production, and Distribution has been issued. Criticisms and suggestions of this report have been invited by the committee. The progress report is a constructive document and offers stimulating reading. The committee believes that the problem of balancing the forces of consumption, production, and distribution should be attacked from the following angles: (1) maintaining or increasing the consumption of goods and services; (2) balancing of plant, machinery, and processes against production demands; (3) balancing of distribution agencies against consumer requirements; (4) balancing of man-power against production and distribution demands; (5) controlling of money and credit to satisfy the needs of government, business, and individuals; (6) encouragement of research activity to increase human well-being through development and progress in industry and business; (7) balancing of public works against public needs; (8) balancing of agricultural supply with effective demand.

The committee finds that "technological unemployment"; "wasteful manufacture and distribution"; "general over-production"; "speculation"; "installment buying"; and "breakdown of international trade and credit"—all popular explanations of the present economic situation—are questionable and inadequate. It feels that a post-war deflation, combined with the slackening of opportunity for profitable investment, offers a reasonable hypothesis from which to deduce constructive remedies. This report was prepared by a committee composed of R. E. Flanders, Chairman; L. P. Alford, F. J. Chesterman, Dexter S. Kimball, and L. W. Wallace. A limited number of copies are available at the headquarters of the Council and may be had on request.

Airport Drainage and Surfacing Report Available

The report of the Committee on Airport Drainage and Surfacing, sponsored by the Aeronautics Branch of the U.S. Department of Commerce, by the American Road Builders Association, and by American Engineering Council, is now available for distribution. A limited number of free copies may be had on request from Council's headquarters at 26 Jackson Place, N.W., Washington, D.C.

ITEMS OF INTEREST

Engineering Events in Brief

Civil Engineering for July

Wide Interest was aroused when the huge Chute à Caron obelisk was toppled into place to complete the cofferdamming of the Saguenay River. In the December 1930 issue of Civil Engineering appeared an article by C. P. Dunn, M. Am. Soc. C.E., describing graphically the actual launching of the obelisk and giving a general description of the project. However, the successful accomplishment of this amazing feat would not have been possible without many preliminary tests. In the July issue, Adolph J. Ackerman, Assoc. M. Am. Soc. C.E., presents for the first time the important studies made by the engineers of the Aluminum Company of America in order to discover what factors would determine the path of the falling obelisk and what design would be best adapted to their purpose.

Traffic circles as a solution of the traffic problem at complicated street intersections are discussed by Herbert S. Swan in another article to appear in July. Although the best modern practice attempts to eliminate multiple street intersections, yet there are already in existence many complicated centers that must receive the engineer's careful attention. Mr. Swan illustrates his points with descriptions of recent developments in New Jersey, where the State Highway Commission has been directing a program of highway improvement. Another study of special interest to highway engineers will be presented by D. Grant Mickle, Jun. Am. Soc. C.E., in a paper on the design and use of various types of safety islands for traffic regulation and for the protection of pedestrians.

In an interesting article, W. D. Shepard, of the Bureau of Standards, develops a nomographic chart for determining the "tension of accuracy" for ordinary surveyor's tapes under varying field conditions of support and temperature.

Translation of Agricola's Classic

Inquiries reaching the Engineering Societies Library almost daily indicate that President Hoover's translation of Agricola's classic, *De Re Metallica*, is widely sought after not only by book collectors but by engineers in all parts of the world. A few years ago the work, in which Mrs. Hoover collaborated, could be bought for seven dollars, but as soon as general book collectors discovered that the President was an author, the remaining copies in print were rapidly bought up. Dealers who are informed of its value explain that the book now commands a price of from one to two hundred dollars.

Georg Agricola, German scholar and man of science, was born in 1490 and died in 1555. His book was considered a standard mining treatise in the Middle Ages, and its author is regarded as the "father of mineralogy." A copy of the translation is on file in the library for reference.

Summer Sessions for Engineering Teachers

Two summer sessions for engineering teachers have been announced by the Society for the Promotion of Engineering Education. The session on the teaching of economics to engineering students will be held at the Stevens Institute of Technology, Hoboken, N.J., from July 5 to July 21, inclusive.

The program will be divided into three major parts, the first and most extensive of which will deal with the organization, content, and teaching of courses in economics for engineering students. Attention will be devoted both to general economics and to the economics of engineering. Related courses and curricula will also be dealt with, including accounting, statistics, industrial engineering, engineering administration, and industrial personnel practices. The second division will comprise a series of lectures on general economics and the economics of engineering by teachers, economists, and practicing engineers. The third division will be made up of a series of lectures on current economic topics by prominent men outside the field of engineering education.

The second session of the Society for the Promotion of Engineering Education will deal with the teaching of English to engineering students, and will be held at the Ohio State University, Columbus, from July 11 to July 28, inclusive. The program of the English session will be divided into the following principal parts: principles of teaching in general; organization, content, and teaching of courses in English for engineering students; subordinate duties and activities of the English staff in the engineering college; and lectures by noted writers outside the field of engineering education.

Applications for admission to either session should be addressed to H. P. Hammond, M. Am. Soc. C.E., Director of Summer School, Society for the Promotion of Engineering Education, 99 Livingston Street, Brooklyn, N.Y. An application need consist simply of a letter giving the name and academic title of the applicant, and the institution with which he is connected. No forms or blanks are required.

Electrification of Railroads

In the report recently made public by the Railway Electrification Committee of the National Electric Light Association, the total mileage of track now electrically operated in the United States is given as 4,911, indicating that this country easily leads the world in this respect. The report, the fifth the committee has issued since a detailed study of steam railroad electrification was begun in 1926, shows that the work of electrifying certain railroads, which was started in 1928 and 1929, has continued in the past two years in spite of prevailing economic conditions. Switzerland follows the United States in mileage of electrically operated track with 2,929 miles, and Germany comes next with 2,373 miles. The total trackage in the world is 23,567 miles.

There are in the United States today 21 railways that have some of their lines operated electrically. The Pennsylvania Railroad is now engaged in carrying out the most important electrification project thus far undertaken. It embraces 2,760 miles of track, and will handle both passengers and freight over the most heavily traveled sections in the world. Outside the United States, parts of railways have been electrified in 30 other countries located on all the continents.

The report concludes with a study of the methods by which power is supplied to all the electrifications in the United States. Copies may be secured by application to the National Electric Light Association, 420 Lexington Avenue, New York, N.Y. The price to non-members of the Association is $1.50.

Summer Surveying Camps for Boys

Iowa State College

At Camp Marston, the summer surveying camp for Iowa State College undergraduates, high school juniors of good health and character with an aptitude for science and mathematics will be given instruction in preparation for engineering college work. The camp, on the south shore of Rainy Lake in upper Minnesota, is to be conducted by J. S. Dodds, M. Am. Soc. C.E., professor at Iowa State College, in Ames. For a period of four weeks, from July 23 to August 20, the boys will be offered field and classroom work in surveying and forestry and geology trips conducted by experts. Bunkhouses with open fireplaces or army tents are provided for quarters, and swimming and fishing are available as healthful forms of recreation. Trips to lumber camps, iron mines, flour mills, and ore docks will be provided, all at bare cost.

Stevens Institute of Technology

This summer the Stevens Institute of Technology is continuing its experiment of last year in conducting a camp to aid boys in deciding on the type of college for which they are best fitted so as to prepare themselves for the career that will give them the most satisfaction. Several colleges and industrial organizations are represented in the experiment, which will be conducted at the Stevens Engineering

Camp in Northern New Jersey for two weeks, from August 13 to 27, under the direction of President Harvey N. Davis of the Stevens Institute, in Hoboken, N.J.

Work in surveying and mapping will alternate with lectures given by noted educators and industrialists. In addition, there will be a liberal amount of good healthful sport. The boys will be further helped in estimating their own natural characteristics and abilities by expertly conducted individual and group tests. Boys who will enter college a year from next September are eligible to attend the camp. Last year boys from 36 different schools attended.

Technical Schools Needed

Since engineering colleges, numbering close to 150, and graduating about 9,000 men each year, leave many of the needs of industry unprovided for, it is the rôle of the technical institute, or post-secondary school, to fill these needs, according to the 282-page report on "A Study of Technical Institutes," recently issued by the Society for the Promotion of Engineering Education. This study was made under the general direction of the Board of Investigation and Coordination of that society. Although obtained prior to the present abnormal condition of business, the data collected indicate that there is a noticeable absence of trained men to fill certain positions in industry.

The principal conclusions are that a need exists in our post-secondary scheme of education for a large number of technical schools giving a more intensive and practical training than is now provided by engineering colleges. Those who made the study believe that these post-secondary schools should prepare students for supervisory and technical positions in particular industries, notably in the mechanical and chemical fields; and that the training should be to a less extent for engineering work of a general character. The study indicates that, in an average year, from 40,000 to 50,000 men with proper training could be absorbed by industry, and by trade and technical services.

The study was extended to include the technical institutes both in this country and abroad. Questionnaires were sent to industrial concerns to determine their approximate needs. In contrast to college men, graduates of technical institutes were found to be working largely on production. This is accounted for by the fact that the instruction in technical institutes is more direct in method and more practical in content than that in the average college. It aims to teach more particularly the "how" of doing things, instead of the "why." The college student learns by thinking out the problem; the technical institute student learns by doing.

Copies of the complete report are available from the Lancaster Press, Lancaster, Pa., at $1 each. A 40-page summary of the report may be had gratis as long as the supply lasts, on application to R. H. Spahr, General Motors Institute of Technology, Flint, Mich.

Foundation of the Washington Monument

By Clarence S. Jarvis, M. Am. Soc. C.E.
Principal Hydraulic Engineer, U. S. Engineer Office, Washington, D.C.

The observance this year of the bicentennial of the birth of George Washington, and the consequent revival of interest in all the memorials that have been erected to the honor of the "First American," have recalled much of special interest to engineers. The story of the Washington Monument has always been fascinating to builders; and engineers have been particularly interested in the long controversy over the question of the adequacy of its foundation.

The Washington Monument Today

Shortly after Washington's death in December 1799, Congress passed a resolution, on motion of John Marshall, providing for the erection in the city of Washington of a marble monument to the memory of the first president. The location originally intended was at the intersection of the two axes, running, respectively, westward from the Capitol dome and southward from the White House; but this point fell in the midst of a swamp. A few hundred feet to the southeast was a mound extending to nearly 40 ft. above sea level, which gave more promise of stability. The upper half of this mound was excavated to the top of a 6-ft. gravel stratum, on which a rubble masonry base 80 ft. square was constructed.

After the usual preliminaries and delays attending great enterprises, which amounted in this case to 48 years, the corner stone was laid on July 4, 1848. Six years later, the work was stopped when the shaft had been completed to a height of 150 ft. above the base. It remained at this height for 26 years, while momentous problems were being disposed of. Among the lesser controversies was that regarding the adequacy of the monument's founda-

The Winning Design for the Washington Monument
By Robert Mills, 1836

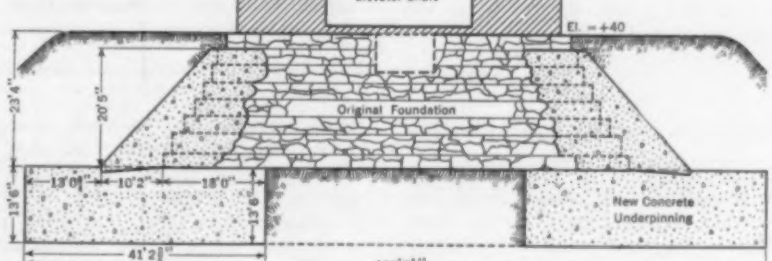


Fig. 1. Method of Strengthening the Old Foundation

tion. From 1878 to 1880 the recommended reinforcement was accomplished. The bearing surface was extended from an 80-ft. to a 126.5-ft. square, by successive trenching and underpinning, and the depth of the substructure was increased from 23.3 ft. to 36.8 ft., as fully described in the *Engineering News* of February 7, 1880, page 49. In Fig. 1 the sectional elevation of the underpinning work shows the method used. A settlement of about 2 in. occurred almost uniformly at the four corners during this phase of the work, and a total settlement of about 4 in. was observed during the entire construction period. Since the shaft was completed, the total settlement has not exceeded 2 in., and during the past 32 years has not increased a measurable amount. The shaft remains plumb.

PREPARATIONS FOR UNDERPINNING THE FOUNDATION, 1879

The enlarged footing covered 16,000 sq. ft., of which the original 80-ft. square represented only 6,400 sq. ft., or 40 per cent. The total weight of the completed structure and backfill was reported as 90,854 tons; therefore the average pressure per square foot is 5.68 tons. A wind pressure of 100 lb. per sq. ft. of exposed surface, corresponding to a wind velocity of 145 miles per hour, would introduce a lateral thrust representing nearly 2.5 per cent of the weight of the superstructure, and because of the advantage in lever arms, might increase the average foundation pressure on the leeward side by nearly 25 per cent, resulting in a total of 7.1 tons per sq. ft. as the average pressure in that area.

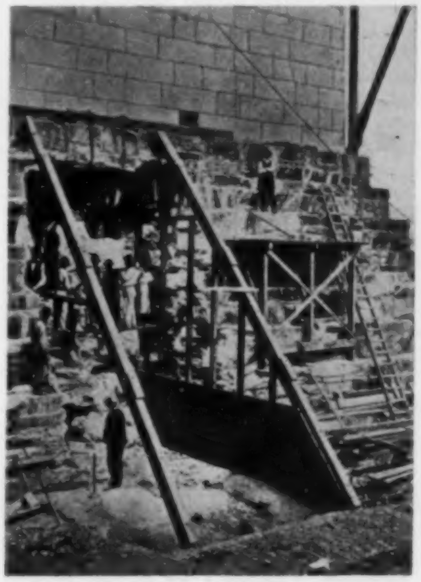
The capstone was placed on December 6, 1884, eight days before the 85th anniversary of the death of Washington. Discussion and concern as to the stability of the structure's foundation continued during the following year. The *Engineering News* of March 14, 1885, contained a strong editorial under the caption, "Will the Washington Monument Stand?" This was followed by contributed technical discussions in the two following weekly issues. *The Washington Star* of February 21, 1885, had published an interview with Col. Thomas Lincoln Casey, later Chief of Engineers, who had charge of the final construction.

"Is it necessary to fill up Babcock Lake immediately to insure the stability of the Washington Monument?" a reporter inquired. "Well," said the Colonel resignedly, "in my opinion the lake should be filled as a precautionary measure.... If it were filled,... not a thing would be left undone for the monument's protection.... The foundation is built right in a marsh. The water stands several inches above that foundation, and the earth upon which it stands is the finest sand imaginable—as fine as any ever used on writing paper.... Now what prevents that section or stratum from spreading out under the weight? Simply the weight of the earth [adjacent thereto]."

THE REBUILT FOUNDATION, JUNE 1880

The lake was duly filled as a precautionary measure. To thisday there are earnest and apparently valid objections urged against any plan proposed for new excavations that might disturb the present equilibrium around the base of the Washington Monument; consequently some of the plans for landscaping have been curtailed, and rightfully so. The monument dominates the landscape; rising impressively on a base 55 ft. square, the shaft tapers on a batter of $^1/_4$ in. per ft. approximately to a 34-ft. square at a height of 500 ft., thence terminating in a pyramidal cap at 555 ft. $5^1/_8$ in. above the floor.

Even the materials of the monument are significant—memorial stones from various states, Potomac gneiss and concrete footings, Maryland marble backed with New England granite, or New England granite faced with Maryland marble, depending on the point of view, but always representing a national contribution and memorial, a concrete expression of the precept, "In union there is strength."



BASE EXTENDED AND SUPPORTED ON A CONCRETE SLAB

Recently the War College, the Lincoln Memorial, the Agricultural Building, the structures along the Mount Vernon Memorial Highway, the Commerce Building, and other departmental structures have arisen on modern prepared foundations where in some instances the stability of the soil was naturally much less than that on which the Washington Monument depends. These new structures stand today without a noticeable line of fracture or settlement.

The total cost of the Washington Monument was published as $1,187,710 in *The Military Engineer*, March–April, 1923, page 99, in the article "Erection of the Washington Monument," by D. L. Weart, Captain, Corps of Engineers, U.S.A. It would be of interest to determine how far that amount would go toward preparing a foundation supported on piles extending to bedrock, in accordance with present standard practice.

Apparently the mound of alluvial soil around the base of the Washington Monument is essential to the stability of its foundation and this artificial knoll may be regarded as a part of the memorial.

Symposium on Aerial Photographic Surveying

AT SYRACUSE, N.Y., June 20–25, the engineering section of the American Association for the Advancement of Science will present a program of interest to all engineers. In the forenoon of June 21 there will be a symposium on aerial photographic surveying. Several papers will be read giving results of work on a series of aerial photographs taken near Alexandria, Va. These photographs are now being worked up independently by means of stereoscopic plotting instruments by members of the U.S. Geological Survey and by the office of the Chief of Engineers U.S. Army; and by analytical methods in the laboratory at Syracuse University. A comparison of the results obtained will be very interesting to all civil engineers engaged in surveying and mapping. Dr. Cooke, of Princeton University, will present a paper on "Photosculpture," or the construction of relief maps by aerial photographic methods, which will no doubt prove of much interest to engineers.

NEWS OF ENGINEERS

From Correspondence and Society Files

W. C. Disbrow, Jr., has opened a consulting office in Tampa, Fla., under the firm name of Hartness and Disbrow. Previously he was Sales Engineer for Wemlinger, Inc., of that city.

E. A. Wood and W. J. Powell, of Dallas, Tex., have announced their association as consulting and city planning engineers, with offices in the Athletic Building.

Arthur L. Reeder, formerly Division Engineer, Mahoning Valley Sanitation District, Youngstown, Ohio, is now Engineer, Designing Division, Bureau of Water of Reading, Pa.

Herbert O. Hartung is affiliated with the St. Louis County Water Company in Chesterfield, Mo.

Leslie W. Stocker has accepted an engineering position with the Public Utilities Commission of San Francisco.

Harry A. Hageman has been named Public Buildings Commissioner of Newton, Mass. He was formerly connected with Stone and Webster, Inc., with headquarters in Boston.

Gonzalo Claudio Muñoz, previously second vice-president and factory manager of the American Pulley Company in Philadelphia, has been appointed vice-president and general manager of that company.

Earl Church has been appointed Associate Professor of Photogrammetry in the College of Applied Science, Syracuse University. He was previously Assistant Professor of Applied Mathematics at the same university.

G. C. Stephens, Jr., formerly an engineer for Atwell-Gustin-Morris, Inc., of Elmhurst, N.Y., is now representing the Electrical Welding Company of America, in Brooklyn, and the Roddis Plywood Company, Inc., of New York.

Edward L. Sutherland is now connected with the U.S. Reclamation Service, in Boulder City, Nev.

L. R. Ames has been appointed State Highway Engineer of the North Carolina State Highway Commission, with headquarters at Raleigh. He was formerly Highway Engineer for the Consolidated Indemnity and Insurance Company, also of Raleigh.

William L. Eager, until recently Construction Engineer for the Precote Sales Company, Des Moines, is now in the Denver office of the U.S. Bureau of Public Roads.

P. J. Freeman, consulting engineer, has become a member of the staff of the Pittsburgh Testing Laboratory. For many years Mr. Freeman was Chief Engineer of the Bureau of Test and Specifications of the County of Allegheny, Pennsylvania.

Leon Fleischmann, formerly Executive Head of Construction and Maintenance of Loew's, Inc., New York, announces the opening of his office at 60 East 42d Street, New York City, as consultant engineer.

R. W. Stiles is Assistant Resident Engineer for the Texas State Highway Department, with headquarters in Corpus Christi.

C. Maxwell Stanley, previously Hydraulic Engineer for the Management and Engineering Corporation of Chicago, has opened engineering offices in Muscatine, Iowa, with Charles H. Young.

Herman Birman has been appointed Assistant Engineer of the Board of Transportation of New York City. He was formerly Topographical Draftsman, Office of the President, Borough of Brooklyn, New York.

R. M. Murray has been transferred from the position of Structural Engineer to that of Resident Engineer with the Washington State Department of Highways.

Fred E. Caldwell, former Eastern Sales Manager for the Besser Manufacturing Company of Newark, has been made vice-president of the Haller Testing Laboratories, Inc., in Plainfield, N.J.

Herbert B. Pope has resigned his position as Superintendent of Construction with the Turner Construction Company of New York City to engage in private practice in Sanford, Fla.

Irving E. Matthews has been recently appointed City Engineer of Rochester, N.Y. He was formerly Superintendent of the Rochester Bureau of Water.

Carl B. Wirsching, who in 1929 was appointed Commissioner of the Board of Public Works of the City of Los Angeles, has been made president of the board.

Harry J. Engel has become associated with the Electrical Railway Presidents Conference Committee in Brooklyn. Formerly he was Stress Analyst for the Glenn L. Martin Company of Baltimore, Md.

William H. Hamilton has taken a position with the Safe Harbor Water Power Corporation of Lancaster, Pa.

Leonard Shaffer has entered the employ of the Robert E. Lamb Company of Philadelphia after severing his connection with the Truscon Steel Company of that city.

Homer B. Pettit, at present Assistant Professor of Military Science and Tactics at the Michigan College of Mining and Technology, will shortly become, by War Department orders, Assistant to the District Engineer, St. Paul District, St. Paul.

A. Herbert Frank has accepted a position as engineer with H. G. Balcom, consulting engineer, of New York City. He was formerly squad boss for the Harris Structural Steel Company.

Changes in Membership Grades

Additions, Transfers, Reinstatements, Deaths, and Resignations

From April 10 to May 9, 1932

Additions to Membership

Baity, Herman Glenn (M. '32), Dean of Eng., Head, Dept. of Civ. Eng. and Prof., San. and Municipal Eng., Univ. of North Carolina, Chapel Hill, N.C.

Bigwood, Burke Lincoln (Assoc. M. '32), Dist. Engr., U.S. Geological Survey, Hartford (Res., 102 Dover Rd., West Hartford), Conn.

Billmyer, Carroll Davis (Assoc. M. '32), Asst. Prof. of Eng., and Supt. of Constr., Rhode Island State Coll., Kingston, R.I.

Blanchard, William Leonard (M. '32), Res. Engr. and Supt. of Constr., Crandall Eng. Co., Cambridge (Res., 49 South Ave., Melrose Highlands), Mass.

Blevans, Jack Austin (Jun. '31), Joseph, Ore.

Blumer, Gabriel (Jun. '31), 19 North Sandusky St., Columbus, Ohio.

Bombergor, Lawrence Joseph (Jun. '31), 206 Fairmount Ave., Ithaca, N.Y.

Brown, Harlan Eugene, Jr. (Jun. '31), care, State Highway Dept., Tillamook, Ore.

Calvert, William Nelson, Jr. (Jun. '31), Junior Engr., Interstate Commerce Comm., 2146 Florida Ave., N.W., Washington, D.C.

Camblos, Lucius Elmer (Assoc. M. '32), Engr., A. Raymond Raff Co., Philadelphia (Res., 26 South Harwood Ave., Kirklyn, Upper Darby P.O.), Pa.

Carpenter, Charles Harold (Jun. '31), 538 Westchester Ave., Port Chester, N.Y.

Carter, Rufus Henry, Jr. (Jun. '32), Draftsman, State Highway Dept.; 223 Sante Fe Ave., Santa Fe, N.M.

Chamberlin, Clarence van Clinton (Assoc. M. '32), Supt., Edw. M. Waldron, Inc.; Shrewsbury Ave., Red Bank, N.J.

Christensen, John Joseph (Jun. '32), Eng. Asst., Board of Transportation, New York (Res., 1143 Clove Rd., West New Brighton), N.Y.

Clintsman, Joseph Orville (Jun. '31), Junior Asst. Engr., Grade 1 (Field), State Dept. of Public Works, Div. of Highways; 512 Alexandria St., Carthage, N.Y.

Coleman, MacKay (Jun. '31), Latour, Mo.

Dent, Joseph Baker (Jun. '32), Instr., Eng Drawing Dept., Agri. and Mech. Coll. of Texas, College Station, Tex.

Dickey, Walter Linnaeous (Jun. '32), 5228 Eagle Rock Boulevard, Los Angeles, Calif.

Douglass, Arthur Sylvester (M. '32), Constr. Engr., the Detroit Edison Co., 2000 Second Ave., Detroit, Mich.

Ekovich, Martin Thomas (Jun. '31), 942 Adams St., Waukegan, Ill.

FAIGLE, JOHN EMIL (Jun. '31), Lieut. C.E.C., U.S.N., 11th Naval Dist. Headquarters, San Diego, Calif.

FITLER, GEORGE GORGAS (Jun. '31), 240 West School Lane, Germantown, Philadelphia, Pa.

FOLSE, JULIUS AUDREY (Assoc. M. '32), Curator, Div. of Motive Power and Transportation, Museum of Science and Industry, 1525 East 53d St., Chicago, Ill.

FOSTER, HERBERT BISMARCK, JR. (Jun. '32), Jun. San. Engr., State Dept. of Public Health (Res., 834 Mendocino Ave.), Berkeley, Calif.

FRANCIS, JOSEPH INGHAM (Jun. '31), Chainman, N.Y.C.R.R., M. of W. Dept. (Res., 32 Third St.), Weehawken, N.J.

FURNESS, LAWTON WILLIAMS (Apr. '32), Junior Hydr. Engr., Water Resources Branch, U.S. Geological Survey, State House, Augusta, Me.

GARDNER, GEORGE LEON, JR. (Jun. '32), 5164 Ruthelen St., Los Angeles, Calif.

GARILLI, PAUL (Jun. '31), 19 Baxter St., New York, N.Y.

GIBSON, WILLIAM EVERETT (Assoc. M. '32), Engr. of Tests, State Highway Comm. (Res., 219 North 6th St.), Manhattan, Kans.

GILLMAN, HAROLD LEETON (Assoc. M. '32), County Engr., Meade County, Meade, Kans.

GREENE, GEORGE ARTHUR (Assoc. M. '32), Asst. Res. Engr., State Bridge Dept., Box 1103, Sacramento, Calif.

GROSSART, LEWIS PHAON (Assoc. M. '32), 816 Chew St., Allentown, Pa.

HAILE, CHARLES RADCLIFFE (M. '32), County Engr., Harris County, Houston, Tex.

HANNIGAN, EDWARD JOHN (Jun. '32), care Standard Franco-Americaine de Raffinage, Boite 8, Lillebonne, S.I., France.

HILTON, DONALD CROSS (Jun. '31), 126 Rockingham St., Rochester, N.Y.

HOUGH, LAWRENCE EVERT (Jun. '31), Forks, Wash.

HUEBNER, JOHN BRADY (Jun. '31), U.S. Surveyman, U.S. Engrs., Memphis Dist., Box 97, U.S. Engrs., Memphis, Tenn.

JAFFARI, MEERZA AFSHAR (Jun. '31), 600 East Kingsley St., Ann Arbor, Mich.

JOHNSON, CARL ERIK (Jun. '32), Topographic Draftsman, U.S. Sugar Corp., Box 590, Clewiston, Fla.

JONES, ALBERT SCARBOROUGH (Jun. '31), 3912 Pine St., Greenville, Tex.

JONES, GILES PAUL (Assoc. M. '32), Vice-Pres., Cornell Young Co., Box 62, Macon, Ga.

KAUFMAN, HARRY (Assoc. M. '32), 18 Hegeman Ave., Brooklyn, N.Y.

KERR, WILLIAM ALEXANDER (Jun. '31), 1226 One hundred and Twenty-Second St., College Point, N.Y.

KLOBERG, EDWARD (M. '32), Pres. and Treas., Edward Kloberg Inc., 11 West 42d St., New York, N.Y.

KOEBIG, ADOLF HEINRICH, JR. (Assoc. M. '32), Cons. Engr. (Koebig & Koebig), (Res., 2404 Eighth Ave.), Los Angeles, Calif.

LABELL, OLDRIC JOSEPH (Jun. '31), 614 Eighteenth St., N.W., Washington, D.C.

LAWRENCE, HARVEY TICE (Assoc. M. '32), City Engr. and City Mgr. (Res., 522 West Jefferson St.), Mangum, Okla.

LOGAN, ARTHUR LAWRENCE (Jun. '31), A Company Barracks, Randolph Field, Tex.

LOTT, JAMES GUY (Assoc. M. '32), with State Highway Dept., Room 405, Court House, El Paso, Tex.

MACDONALD, JOHN (M. '32), Thompson Starrett Associate Prof., Civ. Eng., Union Coll. (Res., 28 Union Ave.), Schenectady, N.Y.

MAUZY, HARRIS KENNETH (Jun. '32), Draftsman, State Highway Comm.; 1306 Pine St., South Pasadena, Calif.

MERZ, ROBERT HERMAN (Jun. '31), 2932 Hale St., Frankford, Philadelphia, Pa.

MIELDAZIS, JEROME JOHN (M. '32), San. Engr., The Rockefeller Foundation for Govt. of Mysore, Palace Rd., Bangalore, India.

MONROE, ROY HAYDEN (Jun. '32), Junior Hydr. Engr., U.S. Geological Survey, Box 1311, Tucson, Ariz.

NEWCOMB, NORMAN BEST (Jun. '31), Junior Engr., Port of New York Authority, 14th St. and 8th Ave., New York, N.Y. (Res., 425 East 7th St., Plainfield, N.J.)

O'LEARY, WILLIAM ALOYSIUS (Assoc. M. '32), Structural Designer, Board of Transportation, 250 Hudson St., Room 901 (Res., 788 Riverside Drive, Apartment 8-D), New York, N.Y.

PINYAN, RONALD AUGUST (Jun. '32), Junior Engr., Met. Water Dist. of Southern California, Box 218, Beaumont, Calif.

RAATZ, WALTER ARTHUR (Jun. '31), 205½ West 9th, Austin Tex.

SCHUMACHER, KARL FRITZ (Jun. '32), Junior Engr., U.S. Geological Survey, Water Resources Branch, Los Angeles (Res., 197 East 9th St., San Bernardino), Calif.

SHELDON, ROBERT CLINTON (Assoc. M. '32), Junior Engr., Section of Surveys, The Panama Canal, Box 1082, Balboa, Canal Zone.

SHUNTILL, FRANK ROBERT (Assoc. M. '31), Structural Draftsman, Allegheny County Dept. of Public Works, Bureau of Bridges, Div. of Design (Res., 134 Teece Ave., Bellevue), Pittsburgh, Pa.

SMITH, ARTHUR ANDREW (Jun. '31), 15 Wendover St., Dorchester, Mass.

SMITH, DAVID OLIVER (Assoc. M. '32), Div. Engr., Bituminous Service Co. (Res., 410 North Matlack St.), West Chester, Pa.

SOMMA, GEORGE EDWARD (Jun. '31), 28 Rathbun Ave., White Plains, N.Y.

SORING, ARTHUR RANDOLPH (Jun. '31), Woodburn, Ore.

SYVERSEN, GUSTAV RANDOLPH (Jun. '31), 33 Valencia Ave., Randall Manor (S.I.), N.Y.

THOMPSON, GEORGE DELAMATER, JR. (Jun. '31), R. D. 1, Box 101, Rensselaer, N.Y.

VICKERY, ALBION KENT (M. '32), Chf. Engr., City and County of Denver (Res., 2088 Forest St.), Denver, Colo.

WALLIN, FRANK ALTON (Jun. '32), 138 West 58th St., Apartment 9-D, New York, N.Y.

WARNER, HERBERT DIEL (Jun. '31), Box 335, Covington, La.

YANDA, ALFRED DANIEL (Jun. '32), Senior Asst. Civ. Engr. for Cuyahoga County Engr. (Res., 4293 East 128th St.), Cleveland, Ohio.

MEMBERSHIP TRANSFERS

BARDSLEY, CLARENCE EDWARD SOLOMAN (Assoc. M. '29; M. '32), Deputy County Engr., Phelps County; Cons. Engr.; Prof., Hydr. Eng., Missouri School of Mines and Metallurgy, Univ. of Missouri, Box 88, Rolla, Mo.

BROWN, HERBERT HENRY (Assoc. M. '28; M. '32), Engr. in Chf. of Design and Constr. of Pumping Stations, City of Milwaukee (Res., 2959 North 36th St.), Milwaukee, Wis.

BUSH, LEE MARSHALL (Assoc. M. '17; M. '32), City Engr. (Res., 1625 West 31st St.), Oklahoma City, Okla.

CATE, CHARLES EDWARD (Assoc. M. '13; M. '32), Chf. Engr., S.P.R.R. of Mexico (Res., 1120 Avenida La Paz), Guadalajara, Jalisco, Mexico.

CROFOOT, DAVID WILSON (Jun. '29; Assoc. M. '32), Project Engr., State Highway Dept., Div. 5, Jefferson City, Mo.

EMANUEL, MORRIS CABLE (Assoc. M. '13; M. '32), Engr., James Black Masonry & Contr. Co., 801 Louderman Bldg. (Res., Warson Rd., R. R. 1, Box 752), St. Louis, Mo.

KAUFHOLZ, WILLIAM (Jun. '27; Assoc. M. '32), Squad Leader, Bethlehem Steel Co., Sparrows Point (Res., 1114 North Patterson Park Ave.), Baltimore, Md.

KELLY, IRA DAVID SANKEY (Jun. '28; Assoc. M. '32), Designer, State Highway Comm. (Res., 1500 Stringham Ave.), Topeka, Kans.

KRUSE, PAUL FREDERICK (Assoc. M. '26; M. '32), care, Sanderson & Porter, 52 William St., New York, N.Y.

PETTIGREW, ROBERT LESLIE (Assoc. M. '22; M. '32), Mgr., Haitian American Development Corp., Cape Haitien, Haiti.

RENZ, EDWIN WILBERT (Assoc. M. '20; M. '32), Dist. Engr., The Austin Co. (Res. 5024 Osage Ave.), Philadelphia, Pa.

STARKWEATHER, WALTER HALLETT (Assoc. M. '29; M. '32), Engr. of Surveys, City Engrs. Office, Dept. of Public Works, City Hall (Res., 11645 Pinehurst Ave.), Detroit, Mich.

TURNER, WILL LAWRENCE (Jun. '30; Assoc. M. '32), 203 South 7th St., Martins Ferry, Ohio.

RESIGNATIONS

BEERS, LESLIE CARL, Jun., resigned Apr. 26, '32.

BROSSARD, LOUIS FISHER, Jun., resigned Apr. 13, '32.

EADES, CHARLES BENJAMIN, Assoc. M., resigned Apr. 11, '32.

KIBBEY, BISCOE ALBERTSON, Assoc. M., resigned Apr. 29, '32.

MENDELSOHN, ISADOR WILLIAM, M., resigned Apr. 11, '32.

MILLER, SAMUEL OSGOOD, M., resigned Apr. '26, '32.

SMOLEY, CONSTANTINE KENNETH, Assoc. M., resigned Apr. 14, '32.

STUPP, OSCAR CENTURY, Jun., resigned Apr. 13, '32.

DEATHS

ALDRICH, TRUMAN HEMINWAY. Elected M., May 4, 1881; died Apr. 28, 1932.

ALLAN, PERCY. Elected Assoc. M., Apr. 1, 1896, M., Oct. 1, 1902; date of death unknown.

BRECKINRIDGE, GEORGE CASTLEMAN. Elected Assoc. M., Feb. 25, 1924; died Apr. 27, 1932.

CAMPBELL, GEORGE RAYMOND. Elected Assoc. M., Aug. '31, 1915, M., Apr. 21, 1920; died Apr. 1, 1932.

CHAMBLIN, ALGA ROSS. Elected Assoc. M., Dec. 6, 1915, M., Apr. 21, 1920; died Apr. 28, 1932.

CHRISTENSEN, JOHN CHRISTIAN VALDEMAR. Elected M., Oct. 1, 1928; died June 16, 1931.

ELA, ARTHUR JOHN. Elected M., Aug. 18, 1930; died Mar. 20, 1932.

GARRATT, ALLAN VINAL. Elected M., Mar. 7, 1921; died Apr. 30, 1932.

HANNA, WILLIAM JOHN. Elected M., Mar. 15, 1926; died Jan. 21, 1932.

HARTMAN, RUSSELL THEODORE. Elected Assoc. M., May 4, 1909; M., Nov. 1, 1910; died Mar. 16, 1932.

JENSEN, ANDREW MARTIN. Elected M., Mar. 5, 1928; died Apr. 26, 1932.

KEEFER, CHARLES HENRY. Elected M., Oct. 7, 1908; died Apr. 12, 1932.

LINNELL, HERBERT PRESCOTT. Elected Assoc. M., May 2, 1906, M., Feb. 4, 1914; died Feb. 25, 1932.

MAILEY, JOHN BRUCE. Elected Jun., Apr. 30, 1912, Assoc. M., May 15, 1917; died Apr. 29, 1932.

MOCK, WESLEY CHARNOCK. Elected M., Dec. 15, 1924; died Sept. 15, 1931.

PITCHER, SAMUEL HENRY. Elected M., Mar. 2, 1909; died Mar. 15, 1932.

REYNOLDS, ABRAHAM MOREAU. Elected M., Nov. 30, 1909; died Apr. 7, 1932.

ROBERTS, EARL IVAN. Elected M., Nov. 14, 1927; died May 4, 1932.

SMITH, FRANCIS PITT. Elected M., Nov. 30, 1909; died Apr. 19, 1932.

SMITH, JOHN HAMMOND. Elected M., Oct. 21, 1924; died Apr. 13, 1932.

SUMNER, ROBERT SWAN. Elected Assoc. M., June 3, 1903, M., Nov. 5, 1907; died Apr. 23, 1932.

VON SCHON, HANS AUGUST EVALD CONRAD. Elected M., Sept. 2 1902; died Dec. 25, 1931.

TOTAL MEMBERSHIP AS OF MAY 9, 1931

Members	5,862
Associate Members	6,374
Corporate Members	12,236
Honorary Members	18
Juniors	2,955
Affiliates	123
Fellows	5
Total	15,337

Men Available

These items are from information furnished by the Engineering Societies Employment Service with offices in Chicago, New York, and San Francisco. The Service is available to all members of the contributing societies. A complete statement of the procedure, the location of offices, and the fee is to be found on page 97 of the 1932 Year Book of the Society. Unless otherwise noted, replies should be addressed to the key number, Engineering Societies Employment Service, 31 West 39th Street, New York, N.Y.

Construction

Highway and Hydraulic Engineer; Assoc. M. Am. Soc. C.E.; 37; married; 9 years experience in highway design, location, and construction; 7 years hydraulic experience on investigations, design, and estimates. Recently resident engineer on construction. Power house, 75,000 hp. Desires position where previous experience will be of value. Available on short notice. Location preferred Western, although not essential. D-732-324-A-2 San Francisco.

Civil Engineer; Jun. Am. Soc. C.E.; graduate of Cornell University; 5 years experience in the construction of tall buildings, factories, warehouses, and shops. Able to handle superintendence of job for contractor or engineering firm. Estimating and design experience. Available immediately. D-820.

Estimating-Purchasing and Office Management; Assoc. M. Am. Soc. C.E.; 49; Protestant. Graduate civil engineer desires position with general contractor on any kind of construction. Familiar with pricing and general make-up of proposals. Best of references. Detailed record on request. Will go anywhere. Has following of best line of subcontractors. D-751.

Civil Engineer; Assoc. M. Am. Soc. C.E.; 34; married; M.S. and C.E., Purdue University, June 1932; 3 years field work on reinforced concrete, steel highway bridges, inspection, surveys, and layouts; 2 years on design and construction of bridges, water filtration and softening plants, and municipal incinerators. Desires connection with construction company, consultant, or architect, field or office. D-864.

Design

Designer-Draftsman; Jun. Am. Soc. C.E.; B.S. in C.E.; 5 years experience designing and detailing steel and concrete buildings; 1½ years detailing and designing bridges and viaducts for New Jersey State Highway Commission. Location immaterial. D-859.

Structural Engineer; Assoc. M. Am. Soc. C.E.; university graduate; M.S., University of California; 3 years field and survey experience; 6 years experience in design and drafting of steel and reinforced concrete structures and buildings (foundations and superstructures). Especially qualified to handle complicated jobs with little or no supervision. C-3351.

Water Works Designing, Construction, and Operating Engineer; M. Am. Soc. C.E.; 48; married; perfect health; 27 years experience in design and construction of filter plants, water-softening plants, dams, tanks, pipe lines, etc., with utility companies building and operating water plants. Location anywhere. Best references. B-5581.

Civil and Structural Engineer; Jun. Am. Soc. C.E.; 28; B.S. in C.E. and C.E. degrees; about 5 years experience in New York City as a designer, detailer, draftsman, checker, and estimator of steel and reinforced concrete. References and samples of work sent on request. C-6186.

Civil Engineer; Jun. Am. Soc. C.E.; 28; married; graduate; 5 years with steel fabricating concern, principally on bridges. Desires designing and estimating work; primary consideration is to secure this experience. D-860.

Engineer; Assoc. M. Am. Soc. C.E.; 30; single; industrious; good personality; university graduate; experienced in structural design. Location immaterial. Salary secondary. C-3400.

Graduate Engineer; Assoc. M. Am. Soc. C.E.; 32; married; 1 year instructor machine design; 4½ years on design and 4 years on construction of large hydro-electric and steam power plants, including power studies and reports; 1½ years on design of industrial plant equipment. Desires position on design or construction, or teaching technical subjects. D-880.

Architectural Engineer; Jun. Am. Soc. C.E.; single; university graduate, 1929; detailing and designing of details, American Bridge Company, July 1929 to May 1932; 2 years drafting, telephone company. Excellent college record and references. Available now. D-927.

Executive

Resident Engineer on Any Construction; Assoc. M. Am. Soc. C.E.; 56; married; 29 years experience on railroad and tunnel construction; bridge and road design, location, and construction; design, construction, and cost data expert on terminal projects; and design and construction experience on drainage and flood protection projects. Consulting work for 9 years. Salary subordinate to opportunities. Available immediately. Location anywhere. D-766-324-A-4.

Structural Engineer; Assoc. M. Am. Soc. C.E.; 33; married; graduate; 11 years experience designing large bridges of steel and concrete. Qualified to direct design of any type of fixed or movable span (lift, bascule, or swing). Actively engaged in design of $40,000,000 worth of work. Last 4 years in charge of design. Location immaterial. Available immediately. D-768.

Chief Engineer-Executive; M. Am. Soc. C.E.; registered in Pennsylvania. Wide knowledge of railroad location, construction, and maintenance. Inspection and reports on properties. Several years in Mexico. Speaks Spanish. Good health. Wants connection here or in foreign countries as representative or in active charge of property development and operation. B-7058.

Consulting Engineer; M. Am. Soc. C.E.; American; graduate engineer; wide experience in connection with various industries, particularly the manufacture and fabrication of steel; desires connection with a large bank or financial institution as technical advisor. Member of various national engineering societies with large acquaintance. Qualified to report on different industries. C-7790.

Graduate Civil Engineer; Assoc. M. Am. Soc. C.E.; 8 years varied structural experience in drafting, design, and construction; estimates, inspection, surveys, and layouts for steel and concrete structures and track work. Capacity to assume responsibility. Desires connection with construction company, consultant, contractor, or architect, in field or office; also sales-engineering or instructorship. C-2605.

Structural Engineer; Assoc. M. Am. Soc. C.E.; 31; married; C.E. and M.S. degrees; licensed professional engineer; 10 years experience on steel and concrete including 3 years of college teaching; recently completed revision of well known structural textbook; Middle Western location preferred. D-839.

Civil Engineer; Assoc. M. Am. Soc. C.E.; 30; C.E. degree; 4 dependents; unusual experience—surveying, 1 year—structural drafting, 2 years—designer, 6 years detailed design, stress analysis, following bridge structures; simple spans, cantilevers, arches (steel, concrete), suspension, continuous, rigid frames. Desires position—engineering organization—opportunity work into firm. Teaching considered. Available immediately. D-716.

Civil Engineer; Assoc. M. Am. Soc. C.E.; 40; married; registered professional engineer, Pennsylvania; 20 years experience in design, construction, and estimating on municipal works for city of Philadelphia, specializing in drainage, sewer, and sewage disposal projects, including steel and reinforced concrete structures. Responsible charge for past 8 years. Available July 1. D-851.

Civil Engineer-Railroad Specialist; M. Am. Soc. C.E.; 27 years experience—partly foreign—in railroad reconnaissance-survey, design, estimate, and construction, including classification, freight and passenger yards, also union terminals; 15 years in responsible charge. Speaks German and French. Splendid references. Will consider moderate salary and any country. Available immediately. B-6250.

Highway Engineer; Assoc. M. Am. Soc. C.E.; 32; married; 2 years experience railroad maintenance-of-way work and location; 12 years experience all phases of highway engineering—location, drafting, plan design, and construction. Work on pavements. Available for work in any capacity. Location in South preferred, but will go anywhere. D-865.

Civil and Industrial Engineer; M. Am. Soc. C.E.; graduate; registered engineer and architect in two states. Experienced in organization and supervision of office and construction forces. Design and construction of housing groups for state and private interests, including water lines and sewer systems; hydro-electric developments; chemical and other industrial plants. B-2835.

Graduate Civil Engineer; Assoc. M. Am. Soc. C.E.; 32; married; 10 years experience in surveys, plans, and construction of state and Federal-aid highways; 1 year sales promotion. Desires permanent connection with large construction company or industrial organization. Location immaterial. Available immediately. D-725.

Civil Engineer; Assoc. M. Am. Soc. C.E.; married; 20 years experience in water supply, filtration, sewerage, sewage disposal, dams, bridges, paving, highways, structural and reinforced concrete. Competent designer and field and construction engineer; 2 years contract work; 2½ years management ready-mixed concrete business. Location anywhere. B-8942.

Civil Engineer; Assoc. M. Am. Soc. C.E.; experienced in the design of concrete bridges, culverts, dams, etc.; also road construction and surveying; street traffic surveys, analysis of route and volume, and parking and traffic recommendations. Interested in teaching. D-875.

Executive Engineer-Sales Manager; M. Am. Soc. C.E.; 44; for past 15 years chief engineer and sales manager of structural steel fabricating companies, specializing in supervision of estimating, designing, pricing, and sales of all types of steel structures. Economical design, fabrication, construction, and arc welding featured. Also 3 years experience in general contracting business. New permanent connection desired. C-5095.

Executive, Construction, Designing, and Contract Engineer or Manager; M. Am. Soc. C.E.; 32 years combined experience covering design, construction, investigation, appraisal, and reports of water supplies and installations, sewers and sewage disposal, dams, tunnels, bridges, harbor works, and foundations. Detailed experience submitted on request. East desirable. D-818.

Civil and Industrial Engineer; M. Am. Soc. C.E.; experience covers preliminary investigations, engineering and financial reports, design and construction of hydro-electric and steam power projects, industrial developments and commercial buildings, also development, maintenance, and consulting work for large chemical and industrial plants. Desires position where executive ability is required. C-6336.

Civil Engineer; M. Am. Soc. C.E. for 22 years. Positions 1889 to date: first assistant engineer, P. & W. Ry., 7 years; assistant engineer and engineer, Bureau of Parks, Pittsburgh, 6 years; member engineering firm Pittsburgh, 13 years—as such, chief engineer on design, construction, electric railroad; engineer large suburb, 11 years; engineer large oil and gas company last 8 years. Work first consideration, pay secondary. B-8134.

CIVIL ENGINEER; M. Am. Soc. C.E.; M. Inst. Struct. E., F. R. S. A. (London); 30 years experience design and construction of steel and reinforced concrete, industrial and commercial buildings, bridges, railways, harbors, and municipal work. Experience in England, India, and Australia. Available on short notice. D-899.

CIVIL AND DESIGNING ENGINEER; M. Am. Soc. C.E.; B.S. in C.E.; 15 years experience in municipal engineering. Sewers, paving, grade separation, water supply, and contingent surveys. Structural experience in reinforced concrete and steel buildings. Good references. Available immediately. D-900.

CIVIL ENGINEER; Assoc. M. Am. Soc. C.E.; executive capable of organizing, designing, or building commercial plants; background of diversified practical experience in this and foreign countries. During past 10 years has designed and supervised construction of industrial plants representing investment of over forty million dollars. Qualified to design and build plant for purification of cotton-linters and for producing nitro-cotton of low viscosities. D-855.

CIVIL ENGINEER; Jun. Am. Soc. C.E.; 31; single; 5 years varied experience including railroad work, concrete and steel design, irrigation, and drainage. Speaks Spanish. Desires position with consulting or general engineering firm where past experience and ability to work hard can be used to some advantage. Location immaterial. D-905.

JUNIOR

CIVIL ENGINEER; Jun. Am. Soc. C.E.; Affiliate, A.S.M.E.; 26; single. Graduate of University of Illinois; passed U.S. Civil Service Junior Engineer Examination. Desires position in any line of civil engineering, preferably structural or hydraulic works. Salary secondary. Location anywhere. D-392.

CIVIL ENGINEER; Jun. Am. Soc. C.E.; 24; single; graduate of Polytechnic Institute of Brooklyn, 1931; C.E. degree. Desires position in any branch of civil engineering or work involving mathematics. Speaks Spanish and Italian. Salary secondary. Location immaterial. D-728.

CIVIL ENGINEER; Jun. Am. Soc. C.E.; 28; single; B.S. in C.E.; 2 years experience in railroad construction, drafting, and valuation work; 18 months experience in general surveys and pipe line construction. Desires opportunity to gain experience. Salary secondary. Location immaterial. Available at once. D-808.

CIVIL ENGINEER; Jun. Am. Soc. C.E.; 22; single; graduate of Rensselaer Polytechnic Institute; experience with civil and sanitary engineer doing office and field work, including work on field party, inspecting, drafting, and computing and plotting; desires civil engineering experience. C-9813.

CIVIL ENGINEER; Jun. Am. Soc. C.E.; 26; graduate of University of Minnesota; 5 years experience on railroad location, construction, and maintenance as draftsman, instrumentman, and assistant to division roadmaster. Desires position with railroad, contractor, consulting engineer, or industry in any engineering or sales work. Good college record and references. D-817.

CIVIL ENGINEER; Jun. Am. Soc. C.E.; 23; single; graduate of Ohio Northern University, 1929; 1 year as instructor of civil engineering in recognized school; 2$^1/_2$ years on high-grade highway and bridge construction work; passed U.S. Civil Service junior engineer examination. Available now. Location immaterial. C-7777.

CIVIL ENGINEER; Jun. Am. Soc. C.E.; 25; married; registered civil engineer in Michigan; B.S. in geodesy and surveying; M.S. in sanitary engineering expected in June; 20 months office experience, mostly reinforced concrete detailing; 14 months inspection and field engineering on construction work; knowledge of accounting and bookkeeping. D-840.

CIVIL ENGINEER; Jun. Am. Soc. C.E.; 26; married; graduate of Massachusetts Institute of Technology, 1928; 3$^1/_2$ years on power development project, in responsible charge of analysis of hydrologic data, stream gaging, and preliminary design of various types of dams, also flood control. Available at once. Location immaterial. D-841.

GRADUATE CIVIL ENGINEER; Jun. Am. Soc. C.E.; 25; 13 months with New York State Highway Department on construction, surveys, and design; good draftsman; passed U.S. Civil Service examination for junior civil engineer. Desires work in any branch of civil engineering. Available immediately. Location immaterial. References. C-7666.

CIVIL AND HYDRAULIC ENGINEER; Jun. Am. Soc. C.E.; 27; married; B.S. in civil and M.S. in hydraulic engineering from leading technical colleges. Experienced in surveying, public utility operation, and production. Particularly qualified for investigations, cost analyzing, operating studies, index method testing of hydro plants. Desires research, teaching, or public utility connection. Location immaterial. C-4487.

GRADUATE CIVIL AND CONSTRUCTION ENGINEER; Jun. Am. Soc. C.E.; 23; graduate of Case School of Applied Science, 1930; 1$^1/_2$ years experience on bridge substructure, dam and railroad construction as field engineer and assistant to chief engineer, making plant lay-outs, estimates, and design. Desires opportunity in any civil engineering work. D-883.

MISCELLANEOUS

GRADUATE CIVIL ENGINEER; Assoc. M. Am. Soc. C.E.; 34; is establishing a manufacturers' agency in the vicinity of Harrisburg, Pa. Will include territory within 100-mile radius, including Washington, D.C., if desired. Would like to hear from reputable manufacturers of building products and equipment who wish representation in this territory. D-363.

INDUSTRIAL ENGINEER OR FACTORY MANAGER; Assoc. M. Am. Soc. C.E.; unusually good training and background; good personality; broad experience in design, construction, equipment, and operation. Recently manager of one of best known large airplane factories. Knowledge of cost control and budget operation. Seeks connection with consulting engineer or financial organization interested in industrials. Location-headquarters, New York City. B-5702.

SALES

STRUCTURAL AND SALES ENGINEER; Assoc. M. Am. Soc. C.E.; 38; married; graduate; high-class sales executive with over 12 years experience in sales, sales management, and structural engineering, specializing in steel requirements for bridges and buildings. Seeking position with manufacturer or contractor. Qualified district sales manager. Good designer and estimator. Available immediately. D-16.

TEACHING

GRADUATE CIVIL ENGINEER; Assoc. M. Am. Soc. C.E.; 38; married; citizen; degree of C.E. from Swiss Polytechnic University; majored in bridges. Some previous experience teaching; 9 years experience consulting and designing with foremost American concern; extensive experience with indeterminate structures. Interested in teaching subjects of statics, graphic statics, statically indeterminate systems, bridges, and foundations. Fluent French and German. B-5176.

CIVIL ENGINEER; Jun. Am. Soc. C.E.; 26; married; licensed construction engineer and land surveyor in State of New Jersey. Qualified to teach mathematics, science, and civil engineering subjects. Starting salary secondary. Location in New York City or New Jersey preferred. D-198.

GRADUATE CIVIL ENGINEER; Assoc. M. Am. Soc. C.E.; 35; married; 2 years technical teaching; 9 years in responsible positions on large construction projects, including rock and compressed air tunnels, highway and railroad construction, and large concrete retaining walls. Available at once. Will go anywhere. C-9321.

CIVIL ENGINEER; M. Am. Soc. C.E.; professor in a national engineering school of a Spanish-speaking country, and native of that country. Qualified to make technical translations from English into Spanish or vice versa. Abstracts from Spanish engineering articles. Library experience. D-761.

PROFESSOR OF CIVIL ENGINEERING AND DEAN; M. Am. Soc. C.E.; 46; married; 25 years engineering and teaching experience; 12 years as department head. Engineering specialties: highways, concrete, hydraulics, testing, and municipal projects. Educational specialties: organization, administration, and teaching major civil engineering subjects. Cultural interests. Qualified to be dean of engineering. Energetic, active, and cooperative. Qualified personally. Desires change. B-3192.

CIVIL ENGINEERING; Assoc. M. Am. Soc. C.E.; C.E. degree from University of Cincinnati, 1925; 5 years field construction of important steel and concrete structures; 3 years design of large building arches and indeterminate structures; A-1 scholastic record; wishes to teach engineering subjects in college or university. C-9968.

ASSOCIATE PROFESSOR STRUCTURAL ENGINEERING; Assoc. M. Am. Soc. C.E.; married; B.S., M.S., and C.E. degrees from University of Illinois; 3 years experience teaching major courses, structural theory, design, ranking university; 5 years practice, reinforced concrete and steel structures, chiefly Waddell and Hardesty, consultants; cantilever, arch, suspension, movable, continuous-girder spans; technical writer; world-traveler. Desires position, leading university. D-330.

RECENT BOOKS

New books of interest to Civil Engineers, recently donated by the publishers to the Engineering Societies Library, will be found listed here. A comprehensive statement regarding the service which the Library makes available to members is to be found on page 87 of the Year Book for 1932. The statements made regarding the books are taken from the books themselves and this Society is not responsible for them.

DOCK AND HARBOR AUTHORITIES' DIRECTORY 1932. London, Dock and Harbor Authority. 323 pp., 7 × 5 in., cloth, 5s. 6d.

This work lists the harbors of the world, gives the names of the authorities and officers of each, and adds brief information about such factors as depth of water, port facilities, and population.

GRAPHIC SOLUTION OF ROAD AND RAILWAY CURVE PROBLEMS WITH THE AID OF LEMNISCATE TRANSITION CURVES. By F. G. Royal-Dawson. London, E. and F. N. Spon, Ltd., New York, Spon and Chamberlain, 1932. 12 pp., diagrs., 9 × 6 in., paper, $.50.

This pamphlet illustrates the use of the lemniscate transition curves recommended in *Elements of Curve Design* by the same author.

HIGHWAY BRIDGES, DESIGN AND COST. By J. E. Kirkham. New York, McGraw-Hill Book Co., 1932. 395 pp., illus., diagrs., charts, tables, 9 × 6 in., cloth, $4.

The aim of this work is to present methods of highway bridge design which will obtain satisfactory results in the shortest time without sacrificing the presentation of the fundamental principles of mechanics that are involved. It is, the author states, based upon the latest practices of state highway commissions, the U.S. Bureau of Public Roads, and various counties and cities.

INTRODUCTION TO THEORETICAL SEISMOLOGY by J. B. Macelwane and F. W. Sohon; Part 2 SEISMOMETRY, by F. W. Sohon. New York, John Wiley and Sons, 1932. 149 pp., illus., diagrs., charts, tables, 9 × 6 in., $2.75.

A presentation of the mathematical theory of the seismograph, which aims to give the observer an understanding of the principles that underlie that instrument and enable him to test and adjust it and understand its behavior and shortcomings. It is claimed to be the first book in English on the mathematical theory of the seismograph.

PRINCIPLES OF PUBLIC UTILITIES. By E. Jones and T. C. Bigham. New York, Macmillan Co., 1931. 799 pp., charts, tables, 9 × 6 in., cloth, $4.25.

A text on the economics of public utilities, designed for use as a textbook by students and as a manual by officials, engineers, and others interested in public utility problems. The discussion is confined to the utilities supplying electric light and power, gas, street railway service, telephone service, and water. The subjects treated include regulation, valuation, rates, finances, combinations, and public ownership.

CURRENT PERIODICAL LITERATURE

Abstracts of Articles on Civil Engineering Subjects from Magazines in This Country and in Foreign Lands

Selected items from the current Civil Engineering Group of the Engineering Index Service, 29 West 39th Street, New York, N.Y. Every article indexed is on file in The Engineering Societies Library, one of the leading technical libraries of the world. Some 2,000 technical publications from 40 countries in 20 languages are received by the library and are read, abstracted, and indexed by trained engineers. With the information given in the items which follow, you may obtain the article from your own files, from your local library, or direct from the publisher. Photoprints will be supplied by this library at the cost of reproduction, 25 cents per page, or technical translations of the complete text may be obtained when necessary at cost.

BRIDGES

Australia. Construction of Adelaide Bridge, W. C. D. Veale. *Inst. Engr. Australia—Journal*, vol. 4, no. 2, Feb. 1932, pp. 37–50. History of bridges, built since 1837, across the Torrens River, at Adelaide; load specifications and structural features of highway bridge having a total length of 221 ft., main arch of the three-hinged type, 120-ft. span, and 14.5-ft. rise; demolition of old bridge; pile driving; control of concrete manufacture; lighting and architectural treatment of structure.

Concrete Arch, Pittsburgh, Pa. Longest Reinforced Concrete Span, H. W. Hoover. *Safety Eng.*, vol. 63, no. 3, Mar. 1932, pp. 104–106. George Westinghouse Memorial Bridge practically completed; 1,500 ft. from one abutment to the other; 225 ft. at center; central span 460 ft. from pier center to pier center; brief outline of process of construction; safety methods and records.

Construction. Eliminating Falsework in Bridge Building. *Wire Eng.*, vol. 1, no. 10, Dec.–Jan. 1931–1932, pp. 26–28. Three notable examples illustrating the elimination of falsework in bridge building by the use of wire rope for erecting purposes, with special reference to the Fort Snelling-Mendota Bridge consisting of 13 open-spandrel ribbed arches, each 304 ft. long.

Design. Some Common Faults in Bridge Detail, and How to Avoid Them, C. S. Chettoe and H. C. Adams. *Road and Road Construction*, vol. 10, no. 111, Mar. 1, 1932, pp. 67–69. Notes on the design of reinforced concrete retaining walls, bridge abutments, and floors; precision of calculations.

Equipment. Machine and Operations Used in Bridge Construction, J. Thomson. *Mech. World*, vol. 91, no. 2351 and 2353, Jan. 22, 1932, pp. 85 and 86, and Feb. 5, pp. 121 and 122. Steel drilling operations; advantages of jigs; riveting; use of milling machines. (Continuation of serial.) Bibliography.

Military. Constructing Military Pile Bridge, C. L. Hahn. *Military Engr.*, vol. 24, no. 134, Mar.–Apr. 1932, pp. 180–183. Detailed report on the construction of a 132-ft. pile bridge across the Nashua River at Camp Devens, Mass., during May and June 1930; costs and man-hour data.

Models. Demonstrating Bridge Stresses by Working Model. *Eng. News-Rec.*, vol. 108, no. 11, Mar. 17, 1932, p. 389. Model exhibited by Ohio Highway Department at road show in Detroit, made of metal bars interrupted by a short U-shaped bend near the mid-length of the member; the pointer of the dial gage is connected as a multiplying lever to a pair of sliding bars, that extend across the open side of the U-bend, and indicates by deflection any opening or closing of the bend, and therefore the amount of stress set up by load.

New York. Bridging Genesee Gorge with Concrete Arches, F. P. McKibben and R. de Charms. *Eng. News-Rec.*, vol. 108, no. 14, Apr. 7, 1932, pp. 507–510. Veterans' Memorial Bridge in Rochester, N.Y., built in Roman tradition, with semicircular arches and granite facing; main arch of 300-ft. span, with each arch rib on separate foundation; 300-ft. arch constructed on five-hinge steel centers; steel centers erected by cantilevering progressively from abutments; utilizing cable tiebacks.

Railroad, Australia. Bridge Reconstruction on South Australian Railways, R. H. Chapman. *Inst. Engrs. Australia—Journal*, vol. 4, no. 2, Feb. 1932, pp. 51–65. Problems of design and construction on various bridge jobs for the South Australian railways; economics of various projects; design and construction of two long steel truss and trestle bridges over the Murray River, having individual trusses up to 242 ft. in span.

Steel Arch, Sydney, Australia. Sydney Harbor Bridge—II. *Engineer*, vol. 153, no. 3976, Mar 25, 1932, pp 330–332 Specifications, requirements, and materials; particulars of specified loadings; approach spans.

Two-Hinged Steel Arch Bridges, T. C. Grisenthwaite. *Civ. Eng. (Lond.)*, vol 26, no. 309, Mar. 1932, pp. 29–32. Errors involved in the use of approximate-method design; axial thrusts; temperature stresses; deadload and liveload moments and thrusts; comparison of various types of arch bridges; errors due to the use of approximate formula, neglect of rib shortening, neglect of variation in moment of inertia, and to use of circular rib. Before Inst. Structural Engrs.

Suspension. Small Suspension Bridge. *Wire Eng.*, vol. 1, no. 10, Dec.–Jan. 1931–1932, pp. 3–5 and 23–25. Principles of design of narrow suspension bridges of comparatively short span and low-load capacity; structural details and examples from practice.

Sydney, Australia. Asphalt Construction on Sydney Harbor Bridge. *Commonwealth Engr.*, vol. 19, no. 8, Mar. 1, 1932, pp. 287 and 288. Types of asphalt construction employed on main arch, steel approach spans, and roadway approaches; natural rock asphalt, standard sheet asphalt, and mastic asphalt; footways, roadway approaches, and south approach crescent.

BUILDINGS

Chicago. International Exposition Buildings Feature Low-Cost Construction, B. M. Thorud. *Steel*, vol. 90, no. 14, Apr. 4, 1932, pp. 31–34. Development of low-cost construction for buildings of *A Century of Progress*, international exposition in Chicago; truss joists; steel economy.

Conservatories, Design. Federal Conservatory Uses Aluminum-Alloy Framing. *Eng. News-Rec.*, vol. 108, no. 15, Apr. 14, 1932, pp. 539–542. Description of the new conservatory for the U.S. Botanic Garden in Washington, D.C., measuring 284 ft. by 183 ft. by 20 ft. and 88 ft. high; aluminum trusses, purlines, and glazing bars reduce maintenance in moist atmosphere; columns and smaller trusses are of steel; arrangement of trusses in connection of triangular roof with dome of central portion of structure; structural aluminum specifications; aluminum fabrication.

Construction. Foundations, C. S. Proctor. *Engrs. Soc. Western Pa.—Proc.*, vol. 48, no. 2, Feb. 1932, pp. 46–59 and (discussion) 59–63. Transition from pneumatic to open installations in downtown New York; description of some of the most unusual and daring jobs in that city and elsewhere.

Schedule and Plant Layout on Skyscraper Construction, W. G. Luce. *Gen. Bldg. Contractor*, vol. 3, no. 4, Apr. 1932, pp. 7–10. Planning an organization for the construction of the 70-story central unit of the Radio City group in New York City.

Pittsburgh, Pa. Long-Span Steel Framing in Pittsburgh Building. *Eng. News-Rec.*, vol. 108, no. 14, Apr. 7, 1932, pp. 510–512. New 37-story Gulf Oil Building contains no columns in rentable space in tower, utilizes double girders and three-web columns, and provides for removal of some alternate floors to give rooms two stories high and 38 by 100 ft. in plan. Foundations of two types: in tower area, compressed-air caissons carrying from two to six columns each sunk to rock; and in remainder of area spread footings on gravel.

Steel, Welded. Welded Steel-Frame Buildings. *Iron and Coal Trades Rev.*, vol. 124, no. 3342, Mar. 18, 1932, p. 476. Structural for all-welded steel-framed building; data on shop welds.

Underpinning. Underpinning New York Post Office in Pennsylvania Terminal, P. Penhune. *Eng. News-Rec.*, vol. 108, no. 15, Apr. 14, 1932, pp. 543 and 544. Restricted work space and train movements made difficult the work of introducing five new two-column bents to permit of lengthening the train platforms and welding girder stiffeners, and to serve as column bases.

CITY AND REGIONAL PLANNING

Evansville, Ind. Ten Years of City Planning in Evansville, R. W. Blanchard. *City Planning*, vol. 8, no. 2, Apr. 1932, pp. 65–78. Review of progress made during 10-year period, by City Planning Commission of Evansville, Ind.; land-subdivision control; zoning; developing official plan; river-rail terminal.

United States. Brief Survey of City and Regional Planning in United States, 1931, T. K. Hubbard. *City Planning*, vol. 8, no. 2, Apr. 1932, pp. 113–120. Summary figures; notable events; plan reports for 1931.

CONCRETE

Aggregates. Shale and Its Metamorphic Equivalents in Aggregates for Road Work, E. F. Bean. *Pit and Quarry*, vol. 24, no. 2, Apr. 20, 1932, pp. 46–48. Origin and characteristics of shale and its metamorphic equivalents from the standpoint of highway aggregates; analyses of clays, shales, slates, and schists; weathering; specific gravity of Wisconsin stone; shales, slates, and schists as aggregates. Before Highway Research Board.

Beams. Practical Data for Concrete Beams, W. S. Wilson. *Civ. Eng. (Lond.)*, vol. 26, no. 309, Mar. 1932, pp. 33–38. Fundamental formulas; practical design; breadth of flange; stresses at supports of continuous beams; arrangement of steel; beams with uniform loading; beams with one concentrated load at mid-span; beams with two equal concentrated loads at third points; beams with three equal concentrated loads at quarter points; derivation of weight constants; stirrups.

Construction. Mass Concrete Problems Discussed at Meeting. *Eng. News-Rec.*, vol. 108, no. 16, Apr. 21, 1932, p. 588. Report on the second meeting of the American Concrete Institute Committee on mass concrete; laboratory investigations; size of specimens; grouting tests; chemical composition of cement; uplift investigations made on Bull Run and Ariel dams.

Curing. Studies of High-Pressure Steam Curing, J. C. Pearson and E. M. Brickett. *Am. Concrete Inst.—Journal*, vol. 3, no. 8, Apr. 1932, pp. 537–550. Effects of steam curing at pressures of 75, 100, 125, and 150 lb. per sq. in., and of exposures 18, 30, 42, and 66 hours; effect of time on steaming, type of cement, consistency, cement content, age before steaming, and type of aggregate.

Hardening. Notes on Hardening Cements at Boiling Point of Water, P. H. Bates and R. L. Blaine. *Am. Concrete Inst.—Journal*, vol. 3, no. 8, Apr. 1932, pp. 531–535. Study of accelerated hardening of mortars made from several cements at the boiling point of water with only atmospheric pressures used, showing that different cements react quite differently in their degree of hardening.

Proportioning. Designing Concrete for Weight of 271 Pounds per Cubic Foot, C. C. Keyser. *Am. Concrete Inst.—Journal*, vol. 3, no. 8, Apr. 1932, pp. 525–529. Design of concrete mix having weight of 271 lb. per cu. ft.; not less than six bags of cement per cu. yd. of concrete and a compressive strength of at least 2,000 lb. per sq. in. at 28 days used in construction of counterweights of bascule span of Arlington Memorial Bridge, Washington, D.C.; Swedish iron ore and steel punchings used as coarse aggregate.

Railroad Construction. Report of Committee VIII—Masonry. *Am. Ry. Eng. Ass'n—Bul.*, vol. 33, no. 344, Feb. 1932, pp. 621–663. Proposed revisions of specifications for portland concrete, plain and reinforced; principles of design of reinforced concrete arches; progress in science and art of concrete manufacture; foundations; prevailing methods and practices of lining and relining tunnels; status of art of repairing deteriorating concrete.

Shrinkage. Shrinkage of Concrete Whilst Setting, J. H. Walker. *Structural Engr.*, vol. 10, no. 4, Apr. 1932, pp. 180 and 181. Study

of the shrinkage of concrete slabs by means of a simple experimental set up.

CONSTRUCTION INDUSTRY

COSTS. Current Construction Unit Prices. *Eng. News-Rec.*, vol. 108, no. 13, Mar. 31, 1932, p. 490. Unit prices bid on Dam 4, Monongahela River, Charleroi, Pa.; Prosser diversion dam, power plant, and power canal, Washington State; cut-off levee in Indian Grave Drainage District, Ill.; dredging rock and earth in Illinois waterway.

DAMS

CALIFORNIA. El Captain Water-Supply Dam for San Diego. *West. Construction News*, vol. 7, no. 6, Mar. 25, 1932, pp. 158–163. Features of projected hydraulic-fill rock-embankment dam 217 ft. high above stream bed; foundation will be about 25 ft. below stream bed; total cost estimated at $6,000,000.

CONCRETE GRAVITY, AUSTRALIA. Woronora Dam, Australia, G. Haskins. *Civ. Eng. (Lond.)*, vol. 26, no. 309, Mar. 1932, pp. 43–48. Construction of curved concrete gravity dam of 249-ft. maximum height; foundation area grouted with portland cement, grout to depth of approximately 30 ft.; cut-off trench; tunnels.

FAILURE. Earth-Fill Dam Saved from Destruction by Cutting Through Side Embankment. *Eng. News-Rec.*, vol. 108, no. 15, Apr. 14, 1932, pp. 561 and 562. Description of the incipient failure of Hunter's Creek dam; rolled-fill earth embankment 40 ft. high and 500 ft. long, at Northville, N.Y.

FOREIGN. Dams—High, Large, and Unusual—III, P. I. Taylor. *Reclamation Era*, vol. 23, no. 4, Apr. 1932, pp. 74–75. Features of recent high dams built in France, Switzerland, Spain, Germany, Italy, Japan, Chile, Mexico, and other countries; table of highest and largest dams in countries outside of the United States.

HYDRAULIC GATES. Lloyd Barrage and Canals. *Water and Water Eng.*, vol. 34, no. 401, Mar. 21, 1932, pp. 115–118. Description of 66 Stoney type sluice gates of Sukkur Barrage, 60 ft. clear width, from 18$^1/_2$ ft. to 22$^1/_2$ ft. deep; erecting of gates; erecting machines; canal head regulators. (To be continued.)

MODELS. Model Tests Confirm Design of Hoover Dam, J. L. Savage and I. E. Houk. *Eng. News-Rec.*, vol. 108, no. 14, Apr. 7, 1932, pp. 494–499. Study made by the Bureau of Reclamation at the University of Colorado in cooperation with the Engineering Foundation Arch Dam Committee, shows deflections and strains of a 1.240 plaster-celite model under mercury loading measured with high precision; design of dam found safe; deflections on model checked calculated deflections very closely.

FLOOD CONTROL

GREAT BRITAIN. Floods in Thames and Wey Valleys, E. S. Bellasis. *Engineer*, vol. 153, no. 3976, Mar. 25, 1932, pp. 335 and 337. River Wey has catchment area of 338 sq. miles; the scheme for reducing flooding is to increase the discharging capacity of the river by cutting out some of the bends, widening or deepening the channel at some places, and increasing the capacities of the weirs when sluices are fully drawn; the possibility that the Thames floods will be increased by this improvement is considered negligible.

MISSISSIPPI RIVER. Slab-Revetment Equipment, Mississippi River, B. Somervell. *Eng. News-Rec.*, vol. 108, no. 15, Apr. 14, 1932, pp. 554–557. Description of special machines for bank grading and of an elaborate plant for casting concrete slabs and assembling them on steel cables into flexible mats; plant cost over a million dollars; discussion of methods; bank-grading equipment; slab design; sinking, casting, and bank-paving equipment.

FOUNDATIONS

BUILDINGS, UNDERPINNING. Cylinder Underpinning Checks Sinking Foundation, H. Spillman. *Eng. News-Rec.*, vol. 108, no. 15, Apr. 14, 1932, pp. 544 and 545. Settlement of new 40,000-kva. power plant of the Continental Motors Co., at Muskegon, Mich., reaching 15$^1/_4$ in. at lake front and only 3 in. at rear, was checked by supports at critical points until consolidation of ground brought building to rest; supporting concrete cylinders averaging 75 ft. in length.

PILE DRIVING. Interesting Piled Foundation, C. Helsby. *Civ. Eng. (Lond.)*, vol. 26, no. 309, Mar. 1932, pp. 20–22. Methods employed in driving piles for the foundations of the Lancashire Steel Corporation Works at Irlam; driving steel shell piles from hanging leaders suspended from Scotch derricks.

RAILROAD BUILDINGS. Creosoted Pile Foundations for Railway Building Structures, F. R. Judd. *Wood Preserving News*, vol. 10, no. 3, Mar. 1932, pp. 40–47. Information on various types of railway building structures under which creosoted pile foundations have been used; number of specific examples. Before Am. Wood Preservers' Ass'n.

RETAINING WALLS, EARTH PRESSURE. Pressure on Retaining Walls, C. F. Jenkin. *Inst. Civ. Engrs.—Min. Proc.*, vol. 23, paper no. 4867, session 1931–1932, 54 pp. Report on several years experimental study, started at the Oxford University Engineering Laboratory; design of experimental apparatus and results of the measurements of the pressure exerted by sand on walls of many shapes; revised wedge theory; rules for calculating forces; comparison with Resal's results; sand pressure under water; validity of tests on models.

HYDRO-ELECTRIC POWER PLANTS

HOOVER DAM PROJECT, CONSTRUCTION. Automatic Material Batchers at Hoover Dam. *Eng. News-Rec.*, vol. 108, no. 15, Apr. 14, 1932, pp. 534–536. Description of electric equipment installed to batch and mix 280 cu. yd. an hour to meet rigid specifications; composition and consistency of each batch recorded graphically; low-level plant has four 4-yd. mixers and provision for two more; carload of aggregate handled every 8 min.; brief of specifications; features of battery of aggregated batchers with air-operated roller gates, magnet discharge, and overload-removal pockets.

HYDROLOGY, METEOROLOGY, AND SEISMOGRAPHY

AFRICA. Some Hydrological Features of Southwest Africa, D. Holtzhausen. *South African Inst. Engrs.—Journal*, vol. 30, no. 8, Mar. 1932, pp. 205–214 and (discussion) 214–218. Data on: surface features, rainfall, annual rainfall, fluctuations in precipitation, maximum and minimum annual rainfall, intensity of precipitation, periodicity of rainfall, humidity and evaporation, Etosha Pan, water supplies, and rate of run-off.

STREAM FLOW. Stream Flow from Rainfall by Unit-Graph Method, L. K. Sherman. *Eng. News-Rec.*, vol. 108, no. 14, Apr. 7, 1932, pp. 501–505. Run-off history corresponding to rainfall of any duration or degree of intensity was computed by making use of a single observed hydrograph, due to a storm lasting one day, and by estimating the percentages of daily computed run-off for Big Muddy River at Plumfield, Ill., April and May, 1927; computed and observed flows of Delaware River at Port Jervis, N.Y.

INLAND WATERWAYS

EUROPE. First Section of New Canal on Rhine Nears Completion. *Eng. News-Rec.*, vol. 108, no. 15, Apr. 14, 1932, pp. 551–553. Compilation based on papers in French and German, indexed in Engineering Index 1930 and 1931; international navigation and power scheme ultimately will open upper section of Rhine River to modern barges from Strassburg to Basel, distance of 136 miles; 900,000 hp. can be developed.

RIVERS, SILT. Sediments of North China Rivers and Their Geological Significance, W. H. Wong. *Geological Soc. China—Bul.*, vol. 10, 1931, pp. 247–271, 1 supp. map. Silt content of the principal rivers in North China; rate of erosion; building of plain; advance of shore line; Huangho silt studied by J. R. Freeman.

ST. LAWRENCE RIVER. Moving Ocean Two Thousand Miles Inland, A. C. Carton. *Mich. Engr.*, vol. 50, no. 1, Mar. 1932, pp. 12–18. Outline of proposed improvement of the St. Lawrence River and different steps involving diplomatic and engineering problems; the whole territory from Duluth to the Gulf of St. Lawrence has been divided into 6 sections which are described; proposed treaty between United States and Canada; apportionment of expense between countries.

IRRIGATION

CALIFORNIA. All-American and Coachella Canals. *West. Construction News*, vol. 7, no. 5, Mar. 10, 1932, pp. 127–134. Report of preliminary studies, made by the U.S. Bureau of Reclamation, of the diversion dam and desilting works on the Colorado River, and of the 80-mile main canal and 130-mile branch canal that will irrigate over 1,000,000 acres in southern California; the estimated cost for this unit of the Boulder Canyon project is $34,000,000; canals require from 60,000,000 to 65,000,000 cu. yd. of excavation.

HOOVER DAM PROJECT, CONSTRUCTION. Tale of Construction Marvels at Hoover Dam. *Eng. News-Rec.*, vol. 108, no. 16, Apr. 21, 1932, pp. 570–574. Picture of the construction progress at Hoover Dam, one year after work was begun; houses and trees; aggregate plant; gravel pit; disposition of construction force on main contract; concreting preparations; upstream portals; downstream portals.

INDIA. Sukkur Barrage. *Indian Eng.*, vol. 91, no. 10, Mar. 5, 1932, pp. 192–194. Description of one of the world's largest irrigation projects commanding 6,500,000 acres of desert land located on the River Indus in Sind, India; Sukkur Barrage dams the Indus with a 4,600-ft. barrier; draglines used extensively to speed excavation and cut cost; total length of main line canals and branches is 1,600 miles; length of distributaries is 4,622 miles; final feeders to fields may amount to 50,000 miles. (To be continued.)

LAND RECLAMATION AND DRAINAGE

CHICAGO. Steel Pile Bulkhead Wall Retains Deep-Water Fill. *Eng. News-Rec.*, vol. 108, no. 13, Mar. 31, 1932, pp. 468–470. Extension of Lincoln Park in Chicago by use of long steel sheetpiles for deep open-lake seawall; seven million cu. yd. dredge fill adds 365 acres; dredging and filling for boat harbor; cost of completed park improvement will be about $8,000,000.

IRELAND. Drainage of River Bann and Lough Neagh, Ireland. *Civ. Eng. (Lond.)*, vol. 26, no. 309, Mar. 1932, pp. 39–42. Description of works estimated to cost £650,000; including improved river channel, and substitution of sluice gates for weirs at Toome, Portna, and the Cutts; dredging; rock excavation.

MATERIALS TESTING

METALS, DEFORMATION. Recent Researches on Plasticity—I, G. I. Taylor and H. Quinney. *Metallurgist, (Supp. to Engr.)*, Feb. 26, 1932, pp. 25–27. Review of research carried out by authors; maximum stress and maximum strain theories; theory of constant total energy of deformation.

TANKS, STEEL. Tests of Joints in Wide Plates, W. M. Wilson, J. Mather, and C. C. Harris. *Univ. of Ill.—Eng. Experiment Station—Bul.*, no. 239, vol. 29, no. 21, Nov. 10, 1931, 74 pp. Report on experimental study of the efficiency of various types of joints in wide plates as used in the construction of storage tanks for water and oil; tests of: riveted lap and butt joints, joints for which holes are drilled or punched, joints with rivets in single shear and in double shear, and welded joints.

PORTS AND MARITIME STRUCTURES

BREAKWATERS, STEEL. Steel Breakwater, W. G. Caples. *Military Engr.*, vol. 24, no. 134, Mar.–Apr. 1932, pp. 120–122. Structural details of concrete caisson breakwater and steel-sheet-pile shore connection at Waukegan, Ill.; steel breakwaters in Chicago metropolitan area.

CONCRETE. Use of Concrete and Reinforced Concrete in Maritime Navigation Works and Preservation of Such Works in Salt Water, G. F. Nicholson. *World Port*, vol. 20, no. 6, Apr. 1932, pp. 404–428. Causes of deterioration of concrete in sea water; developments for obtaining permanent concrete for sea water; surface and integral waterproofing; economic advantages of impregnated concrete piles as compared with untreated piles; present limitations of impregnation method. Before Fifteenth International Congress Navigation.

SAN FRANCISCO BAY. San Francisco Bay Preparing for New Ships. *Pac. Mar. Rev.*, vol. 29, no. 3, Mar. 1932, pp. 91–95. Port of San Francisco spends ten millions in extensions and betterments; description of work under way.

SHORE PROTECTION. Protection of Coasts Against Sea, With or Without Preponderating Coastal Drift of Materials, J. S. Smith. *World Ports*, vol. 20, no. 5, Apr. 1932, pp. 429–437. General discussion of seacoast erosion, wave action, beach preservation, and similar subjects, with special reference to experience along the Atlantic Coast of the State of New Jersey. Before Fifteenth International Congress Navigation.

ROADS AND STREETS

ASPHALT MIXERS. Development of Rotary Mixers for Hot and Cold Asphalt Mixtures, J. W. Davitt. *Eng. and Contracting*, vol. 71, no. 4, Apr. 1932, pp. 107 and 108. Historical note on the development of asphalt rotary mixers since 1838. Asphalt Paving Technologists.

AUSTRALIA. Road Construction and Maintenance in South Australia, D. V. Fleming. *Quarry and Roadmaking*, vol. 37, no. 422, Mar. 26, 1932, pp. 132–137. Development of highway system since 1839; reconstruction of heavy traffic roads; hot bituminous preparation; penetration with bituminous emulsion; use of tar in emulsions; manufacture of emulsion; tar-asphalt mixtures; maintenance.

BITUMINOUS. Discussion Concerning Adhesion Tension in Asphalt Pavements, V. R. Nicholson. *Roads and Streets*, vol. 75, no. 4, Apr. 1932, pp. 165–173. Theories and methods of measuring adhesion tension and cohesion in liquid-liquid, liquid-solid, and solid-solid system; Nellenstyne's surface tension-temperature curves; Bartell cell; pressure of displacement of some crude oils by water; adhesion tension values for some crude oils against silica; work values in different types of wettings, using crude petroleum oils and silica.

CEMENT - BOUND. Cement - Bound Roads. *Quarry and Roadmaking*, vol. 37, no. 423, Apr. 1932, pp. 165–168. Review of British practice as to construction, materials, plant, and labor; quantities and costs; expansion and contraction joints.

CONCRETE. Laying Concrete Pavements at Barrie, E. Shuter. *Can. Engr.*, vol. 62, no. 13, Mar. 29, 1932, pp. 11 and 12. Construction by day-labor system proves a success at a cost of approximately $1.50 per sq. yd.

CONSTRUCTION. Water-Saving Method of Crusher-Run Base Construction in Desert Sections, D. I. Day. *Highway Mag.*, vol. 23, no. 4, Apr. 1932, pp. 89-91. Description of "slurry base work" method of road construction in arid regions, developed in Kern County, southern California.

EMULSIONS. Settling Fills by Jetting. *Contractors and Engrs. Monthly*, vol. 24, no. 4, Apr. 1932, pp. 27 and 28. Description of water jetty method required of contractors in Illinois on all fills over 3 ft. high.

Use of Bituminous Emulsions in Roadmaking, H. J. Prentice. *Surveyor*, vol. 81, no. 2099, Apr. 15, 1932, pp. 415-417. Discussion of bituminous content; surface dressing; grouting; emulsion macadam; cold asphalt; miscellaneous uses of emulsions; transport, storage, and handling of emulsions. Before Inst. Mun. and County Engrs.

GRADING. Subgrades Design by Soil Surveys in Michigan, A. C. Benkelman. *Eng. News-Rec.*, vol. 108, no. 15, Apr. 14, 1932, p. 550. Outline of the practice developed by the Michigan State Highway Department; soil inspector directs grading operations by means of soil survey preceding construction and frequent inspection of the material disclosed by grading cuts; cost of soil inspection.

GREAT BRITAIN. Road Surfacing Materials. *Quarry and Roadmaking*, vol. 37, no. 422, Mar. 26, 1932, pp. 142-156. Development of British proprietary products, including materials, fillers, concrete mixers, mobile and portable roadmaking plant, spraying and gritting machines, road rollers, scarifiers and finishing plant; transport of road material; surface boxes for heavy traffic.

INTERSECTIONS. Radii of Curbs at Intersections. *Am. City*, vol. 46, no. 4, Apr. 1932, pp. 87 and 88. Report by committee of American Road Builders' Association; demonstration of the advantage of increasing the curb radius on a street carrying two lanes of traffic in either direction; wider curb return desirable; method of determining curb radii geometrically.

LOW COST. How Low-Priced and Durable Residential Streets Are Developed in Alhambra, O. N. Rugen. *West City*, vol. 8, no. 4, Apr. 1932, pp. 11-13 and 29. Re-conditioning by using old material in subgrade and putting on new surface gives satisfactory street at low cost; specifications for surfacing; cost figures.

MACHINERY. Modern Road-Construction Machinery, E. vom Cleff. *Eng. Progress*, vol. 13, no. 2, Feb. 1932, pp. 40-42. Design features and performance data for various sizes of German-made concrete mixers and driers.

MAINTENANCE AND REPAIR. Filling Cuts and Openings in Concrete Pavements, F. D. Woodruff. *Eng. News-Rec.*, vol. 108, no. 15, Apr. 14, 1932, pp. 558 and 559. Restoration of concrete pavement where utility openings have been made or surface failures have occurred; materials; subgrade preparation; preparation of edges; reinforcement; placing concrete mixture; use of admixtures. Before Association Highway Officials of North Atlantic States.

MOUNT VERNON. Design and Construction of Mount Vernon Memorial Highway, R. E. Toms and J. W. Johnson. *Am. Concrete Inst.—Journal*, vol. 3, no. 8, Apr. 1932, pp. 563-584. Selection of routes; highway grade separations; terminal provisions for parking and reversing traffic; provisions for bus stops; construction of pavements and of concrete bridges.

RAILROAD TRACKS, PAVING. Street-Railway Paving Problem, R. H. Simpson. *Am. City*, vol. 46, no. 4, Apr. 1932, pp. 71 and 72. Track construction in Columbus and Cleveland, Ohio; block-type surfacing; concrete between tracks; grooved rail and block pavement.

RHODE ISLAND. Placing Fills in Swamp Areas, C. L. Wooley. *Eng. and Contracting*, vol. 71, no. 4, Apr. 1932, pp. 115-116. Experiences in Rhode Island in constructing fills across ordinary swamps, muck swamps, and peat bogs. Before 1932 meeting of the Ass'n of Highway Officials of the North Atlantic States.

SINGLE-LANE. How Single-Lane Concrete Roads Fit into Highway System, E. M. Fleming. *Concrete*, vol. 40, no. 4, Apr. 1932, pp. 23 and 24. Purpose of single-track roads; cost data on single-lane roads; three classes of single-lane roads.

SWAMPS. New Type of Roadway Tested in France. *Permanent Int. Ass'n of Road Congresses—Bul.*, no. 79, Jan.-Feb. 1932, pp. 14-16. Process of road construction on wet ground developed by Lasseur, chief engineer of roads service, at Alencon, France.

SEWERAGE AND SEWAGE DISPOSAL

CHEMICAL TREATMENTS. Chemical Methods Adopted for Treating Sewage. *Chem. and Met. Eng.*, vol. 39, no. 3, Mar. 1932, pp. 141 and 142. Sewage treatment by chemical precipitation is to be used in plant at Dearborn, Mich.; new clarifying element, pulped waste paper as ready-made floc, is to be introduced.

ELECTRIC DRIVE. Electric Sewage Pumping. *Elec. Times*, vol. 81, no. 2108, Mar. 17, 1932, pp. 353-356. At Abbey Mills station in West Ham, practically all of London sewage, north of the river, has been gathered together and flows in two high-level and three low-level sewers; at present various pumping sets can deal with a maximum of over 1,300 tons per minute; details of station and electrically driven equipment.

EQUIPMENT. Some Considerations in the Design and Operation of Sewage Screening Plant, A. S. Lowe. *Civ. Eng. (Lond.)*, vol. 26, no. 308, Feb. 1932, pp. 26-29. Features of a modern plant for the screening of sewage; endless belt screen driven by waterwheel and cleaned by brush; "Reinch bars"; disposal of screenings.

FINANCING. Financing Sewage Disposal, H. R. Green. *Iowa State College of Agric. and Mechanic Arts Official Pub.—Bul.* 110, vol. 30, no. 43, Mar. 23, 1932, pp. 3-13 and (discussion) 13-15. Cost of sewage disposal plants; methods of financing; legal aspects; financing by special assessment; sewer rental law cost per capita.

PLANTS. Observations and Experiences in Design and Construction of Sewage Purification Works, W. H. E. Makepeace. *Surveyor*, vol. 81, no. 2098, Apr. 8, 1932, pp. 395 and 396 and (discussion) 397-399. Subsidence; grit chambers and screens; sedimentation tanks; sludge disposal; aeration plants; storm water; bacterial beds.

PRISON. Sewage Treatment at Folsom Prison, L. E. Rushton. *West Construction News*, vol. 7, no. 2, Mar. 25, 1932, pp. 153-157. Bar screens, grit chambers, preliminary settling with scum removal, separate sludge digestion, gas collection and heating, aeration and chlorination of effluent, sludge drying and thickening provided by California institutional plant designed for a population of 4,000.

SARANAC LAKE, N.Y. Saranac Lake's Sewage Treatment Plant, H. W. Taylor. *Pub. Works*, vol. 63, no. 4, Apr. 1932, pp. 18-20. Description of modern sewage disposal plant, serving a population of 14,000, constructed at a cost of less than $4 per capita.

SLUDGE. Cardinal Points in Art of Sludge Digestion—A Compressed Summary of Quarter Century of Experience, H. Bach. *Surveyor*, vol. 81, no. 2098, Apr. 8, 1932, pp. 401-402. Artificial control of alkalinity; two-story vs. separate-digestion tanks; artificial heating; stirring; maintenance of anaerobic conditions; limits of digestion; thermophilic digestion.

SURVEYING

AERIAL. Air Mapping as Business, R. Coltharp. *West Flying*, vol. 11, no. 3, Mar. 1932, pp. 24-25. Surveying methods and equipment of Southwestern Aerial Surveys, Inc.

NORTHWEST TERRITORIES. Surveys at Great Bear Lake, 1931, R. C. McDonald. *Can. Min. and Met. Bul.*, no. 240, Apr. 1932, pp. 209-223. Climatic and general data; accessibility by water route or by air; earlier explorations; plan of topographical control; surveying practice; itinerary.

TRAFFIC CONTROL

HIGHWAY TRAFFIC SIGNS, SIGNALS, AND MARKINGS. Improvement in Highway Signs, A. R. Lauer and D. Helwig. *Am. Highways*, vol. 11, no. 2, Apr. 1932, pp. 14, 15, and 19. Design of highway signs based on psychological tests.

TUNNELS

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